

GOT THE STUFF TO FLY A ROCKETSHIP? (p.20)

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Fast Pitch

**HOW TEST PILOTS
SELL FIGHTERS**

***Watch a
Spacecraft
Crash on the
Moon***

**VIETNAM
LEGENDS:
THUDS AND
THUNDER**

**I'm With the
(Astronaut)
Band (p.52)**

Lockheed
Martin F-16

MARCH 2009



Time travel at the speed of a 1935 Speedster?

The 1930s brought unprecedented innovation in machine-age technology and materials. Industrial designers from the auto industry translated the principles of aerodynamics and streamlining into everyday objects like radios and toasters. It was also a decade when an unequalled variety of watch cases and movements came into being. In lieu of hands to tell

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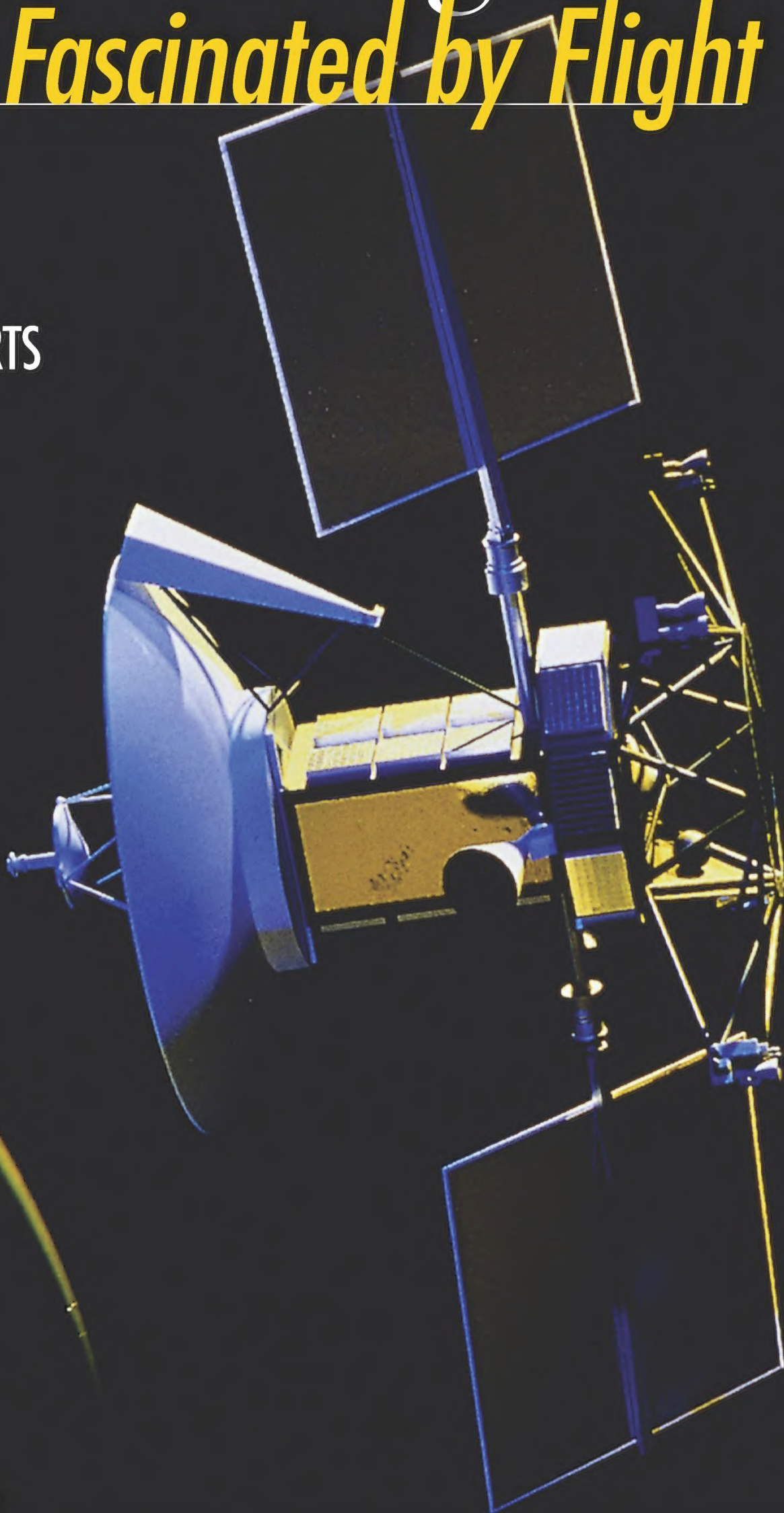
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HISTORY IS NOT ALWAYS
WRITTEN QUIETLY. SOMETIMES IT REQUIRES
A SONIC BOOM.

No person has pushed the limits of man and technology like Chuck Yeager. The year was 1947. Nobody knew if a fixed-wing airplane could break the speed of sound. More curiously, whether a human could survive the tremendous force of that kind of speed. Yeager was already a legend among WWII fighter pilots when he took off in the X-1 that day. Not only did he reach Mach 1 and create the first man-made sonic boom, he did it again fifty years later in an F-15 fighter. His résumé of military and civilian accomplishments is comprehensive enough to consume chapters in aviation history books. If one person defines what it is to be a man among men, he is Chuck Yeager.



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ON THE COVER: Katsuhiko Tokunaga's closeup of a Royal Netherlands Air Force F-16AM shows off the fighter's finer points – just as Captain Gert-Jan Vooren of 312 Squadron did when he flew it at the 2006 Royal International Air Tattoo in Fairford, England. In a highly competitive market (see p. 40), Lockheed Martin has sold F-16s to 24 countries.



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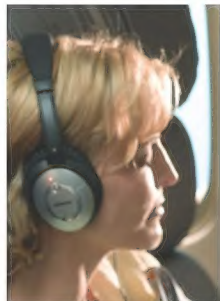


On the Web Site www.airspacemag.com

You may not be able to see a live performance by the astronaut band Max Q (see p. 52), but tune in to our Web site to catch the band's 1995 appearance on ABC's "Good Morning America."

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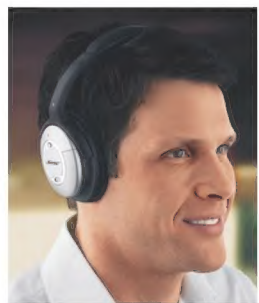


cabin, the bustle of the city or the distractions in the office, Bose QuietComfort 2 headphones help them fade softly into the background with the flick of a switch. You can savor delicate musical nuances without disturbing others. And

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Fast Company

A FRIEND RECENTLY ASKED how we RF-4 reconnaissance pilots defended ourselves during bomb damage assessment flights in Vietnam. Because of how those missions were scheduled, our arrival over the target was as predictable as the sunrise. I gave my friend a one-word answer: Speed. Recce crews flew alone, unarmed, and unafraid (well, two out of three ain't bad), so those of us who flew versions of the McDonnell F-4 Phantom were plenty glad that we had a maximum speed of over 1,400 mph to draw on (see "Where Have All the Phantoms Gone?" Dec. 2008/Jan. 2009).

I've had many opportunities to reflect on those missions whenever I've walked through the Museum's Steven F. Udvar-Hazy Center. We have eight Vietnam-era military aircraft on display there, including those featured in the magazine's new series, "Legends of Vietnam." Vietnam was the first supersonic war, and several of the articles in the series focus on a new generation of jets that changed the nature of air combat. This issue's installment, on the Republic F-105 Thunderchief (p. 60), shows that speed was the savior of countless Thud crews. It was also, I'll admit, one of the reasons a lot of us wanted to fly jets.

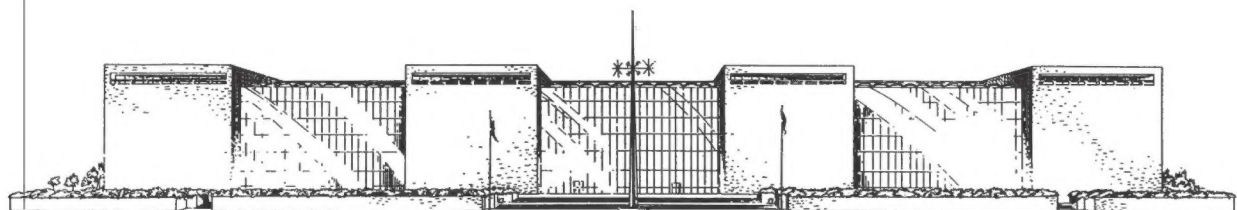
I got to fly the RF-4 on the first of two tours in Vietnam. Before I went overseas, I flew the Chance-Vought F-8U Crusader, an airplane I had wanted to fly since the first time I saw it. I was stationed at Marine Corps Air Station El Toro in California. We didn't have a simulator for the F-8, so to get

the feel of the airplane, you did an intentional aborted takeoff as your first hop. You lined up on the runway, stroked the afterburner, and at 60 knots came out of burner and tried to stop before the end of the runway. That could have been the most dangerous hop I ever made in the aircraft.

The F-8U was the first carrier-based jet fighter capable of exceeding 1,000 mph. Every F-8 pilot wanted to earn a thousand-mile-an-hour pin (awarded by the manufacturer), a feat that was not a given. In the F-4, you can get your Mach 2 pin just by sitting there and adding power. In the F-8, you had to work it, particularly in the older ones. The thing I really liked about the airplane was that there was nothing dainty about it. It was a rugged machine. Even the way you locked the canopy: You pulled a great big lever. There were no micro-mini switches in that baby.

At the Udvar-Hazy Center, all three aircraft—the F-4, F-105, and F-8—are on display. For those of us who flew them, seeing them is an emotional experience; it brings back memories of service, youth, comradeship, and probably more than a few close calls. I'm sure if you've ever visited the Museum with a veteran, you know the airplanes can evoke dozens of stories. For visitors who don't have a veteran handy, we have an award-winning team of docents who can also tell you stories, as well as the history and significance of the aircraft and a good deal about their personalities as well.

■ ■ ■ J.R. DAILEY IS THE DIRECTOR OF THE NATIONAL AIR AND SPACE MUSEUM.





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Letters

WRITE TO US

An Eagle's Odd Course

I was acquainted with several people involved in Hubert Julian's seasoning as an aviator ("The Black Eagle of Harlem," Dec. 2008/Jan. 2009). When Julian flew for his private pilot's license in 1931, using a Fleet 2, he finished up with a spectacular ground loop.

There is some question about the legitimacy of Julian's various military ranks. Certainly his 1924 lieutenancy was self-appointed. He got to be a fairly competent pilot of lightplanes, but he showed little aptitude for heavier models, such as the Bellancas he crashed. The opening picture in your article shows him in his favorite de Havilland Moth Major, used in frequent Paris-London junkets. I enclose an image of him in the *Ethiopia I* seaplane (below).

John Underwood
Glendale, California

A Strike, or a Day Off?

In my review of *Homesteading Space: The Skylab Story* (Reviews & Previews, Dec. 2008/Jan. 2009), a sentence was added that read: "On the last mission, the harried crew staged a one-day work strike." This is an oversimplification.

Mission planners had overscheduled the Skylab 4 crew's activities, and the crew members eventually became exhausted. About halfway into the

mission they called for a discussion of workload; according to *Living and Working in Space: A History of Skylab* (NASA Special Publication 4208; 1983), astronaut Gerald Carr asked NASA: "What can we do if we're running behind and we need to get caught up?" A related issue was the astronauts' need for a small amount of personal time, which mission planners agreed to schedule.

NASA had scheduled days off, but the crew usually worked through them. *Homesteading Space* quotes Carr: "Well, we got to the point where our morale was low, we were feeling lousy, and we were really getting drained. So we said 'Let's take our day off and get a good day's rest.'" This is what some news accounts referred to as a mutiny.

The crew always denied that characterization. *Homesteading Space* quotes Edward Gibson: "There was no 'strike in space' by any stretch of the imagination. What could we threaten to do, go live on the moon?" Gibson complained that writers who reported a strike had not gotten their information from the crew.

Roger D. Launius
Senior Curator, Space History
National Air and Space Museum

Twin Mustang, Twin Claims

I read with incredulity that the U.S. Air Force is fighting for an F-82 Twin Mustang that the Commemorative Air Force had acquired ("Tug-of-Warbird," Soundings, Dec. 2008/Jan. 2009). Those airframes were purchased by the U.S. taxpayers. We are the rightful owners. Unlike the CAF, the U.S. Air Force has no intention of returning the F-82 to flying status. I beseech the CAF to pursue this, and the Air Force to reconsider. Let the lady fly.

Michael Wolf
Jacksonville, Florida

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A portrait of Hubert Julian and a photograph of him in the *Ethiopia I* seaplane, funded by Harlem citizens.

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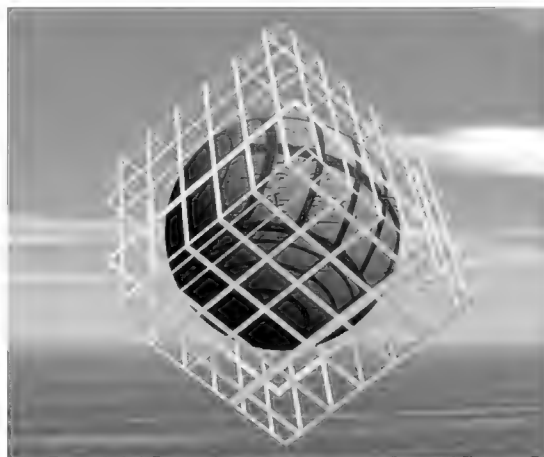
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a Distinguished Teaching Professor at The University of Texas at Austin. Professor Starbird has won several teaching awards, most recently the 2007 Mathematical Association of America Deborah and Franklin Tepper Haimo National Award for Distinguished College or University Teaching of Mathematics, which is limited to three recipients annually from the 27,000 members of the MAA.

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Letters

Phans and Phoes

"Where Have All the Phantoms Gone?" (Dec. 2008/Jan. 2009) dwelled more on the F-4's shortcomings and its present service as a weapons-testing target drone than it did on the aircraft's contribution to the Vietnam War and to military aviation. The article does mention that several countries still fly the Double Ugly, but that's it. And nearly half of the pictures in the article are of the drone variant. It seems that as far as *Air & Space* is concerned, the F-4 is the Rodney Dangerfield of aviation.

J. Michael Weir
Moorpark, California

Editors' note: The following was sent in anonymously:

Low Flight

Oh, I have slipped through swirling
clouds of dust,
A few feet from the dirt,
I've flown the F-4 low enough
To make my bottom hurt,
I've flown in the desert, hills and valleys,
Mountains too,
Frolicked in the trees,
Where only flying squirrels flew.

Chased the frightened cows along,
Disturbed the ram and ewe,
And done a hundred other things
That you'd not care to do.
I've smacked the tiny sparrow,
Bluebird, robin, all the rest,
I've ingested baby eagles,
Simply sucked them from their nest.

I've streaked through total darkness,
Just the other guys and me,
And spent the night in terror of
Things I could not see.

I turned my eyes to heaven,
As I sweated through the flight,
Put out my hand and touched,
The Fire Warning Light.

—Poet unknown

My World and Welcome to It

I can't believe all those folks on VATSIM—the Virtual Air Traffic Simulation Network—actually pretend to be air traffic controllers for "fun" or "to relieve stress" ("Welcome to Cyberairspace," Dec. 2008/Jan. 2009). I'm an air traffic controller—an inglorious and unappreciated job—and when I get off work I try to do anything I can to forget the day.

Mark Harris
Anchorage, Alaska

Corrections

Dec. 2008/Jan. 2009 "Red & The Robots": (1) Pittsburgh's last working steel mill shut in 1979, not 1997. We regret this editing error. (2) Tom Gardner's name was misspelled.

"Where Have All the Phantoms Gone?" The photograph at the bottom of page 32 shows an F/A-18, which entered the Navy in 1980; therefore the photograph was taken after, not during, the Vietnam War. The story editor, not the writer, is responsible.

"Present at Creation": The caption on p. 65 should have identified Tom Beacham as second from left, not right.

"Homesteading Space: The Skylab Story" (Reviews & Previews): Alan Bean and Owen Garriott were both on the second Skylab crew, not on separate crews.

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>>> WHEN GEORGE

Morgan's mother died four years ago, he submitted an obituary to the *Los Angeles Times* chronicling her career as the inventor of hydyne, a rocket fuel that provided the extra kick necessary to thrust Explorer I, America's first satellite, into orbit.

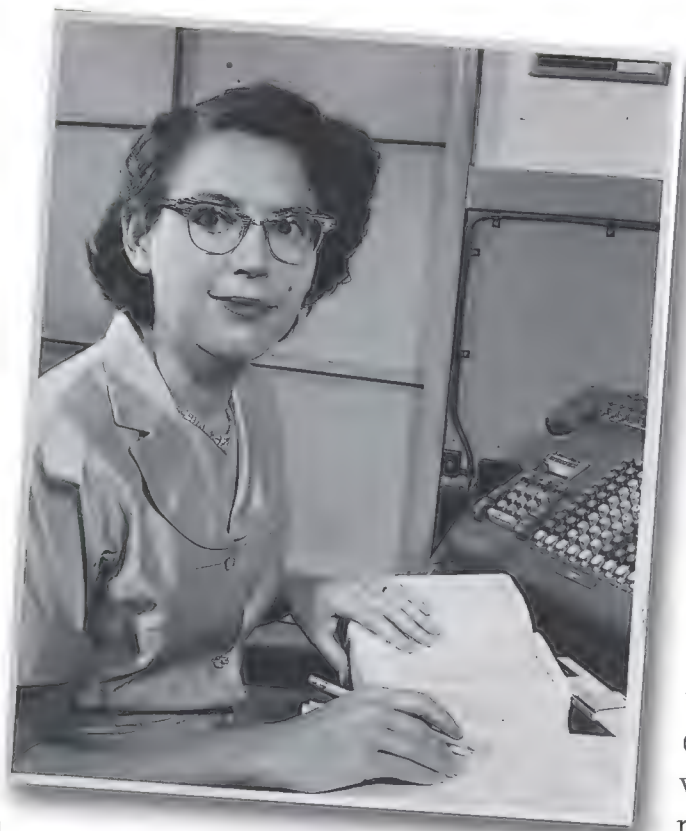
But the *Times* refused to print the obit. "I was told, 'We could not independently verify any of the information in it,'" Morgan recalls. "The problem was that she wasn't in Wikipedia. You couldn't Google her. I realized that my mother was starting to vanish from the historical record."

Morgan, a writer who has several movies, plays, and novels to his credit, literally wrote his mother back into the record. Last November, at

the California Institute of Technology, he watched the premiere of his play "Rocket Girl," billed as the true story of Mary Sherman Morgan, America's first female rocket scientist.

Performed mostly by Caltech students and Jet Propulsion Lab engineers, "Rocket Girl" takes a loving look at a scientist who is forgotten partly because women in the hard sciences were marginalized—a theme that's explored in the play—but largely because she avoided the spotlight.

"She was publicity-shy," Morgan says. "When she was in her 70s, I told her, 'Mom, I'd like to write a book about your life,' and she got furious. She said, 'You will not write a word about me



Portrait of the chemist, with rhinestones and Friden.

while I am alive.'"

Morgan didn't find out about his mother's claim to fame until he was a teenager. He heard the story from his father, Richard Morgan, who had worked alongside her at North American Aviation.

In 1957, after being humiliated by the Soviets' Sputnik, the United States was desperate to launch a satellite. The Navy had failed with its Vanguard rocket. The Army was betting on the team led by Wernher von Braun, but because his Redstone motor didn't have the oomph necessary to reach orbital velocity, North American was hired to formulate a propellant to get the rocket over the hump.

Morgan wasn't technically an engineer—she'd been plucked out of college during World War II to work as a chemist in a weapons plant—but she was North American's top hand in theoretical performance

calculations, and she headed up the rocket fuel team. Her son captures the camaraderie of the young engineers who were the space-race shock

troops, and he comes up with a charming fictional account of his mother's eureka moment.

Late in Act II, despairing that none of the existing propellants will do the job, she goes to church and mentions her predicament to the Irish priest there. The priest tells her: "Recently, I started adding a pinch of Tabasco sauce to give [my brandy] an extra kick.... Maybe that's what you need. Instead of replacing this fuel, you should add something to it. You know—give it an extra kick."

Mary Sherman Morgan did just that, and when the fuel was mixed with liquid oxygen, the combination boosted Explorer I into orbit. Everything worked as she planned, with one exception. Morgan recalls, "She once told me, 'It wasn't called "hydyne" originally. I wanted to call it "bagel." 'Why bagel, Mom?' 'So it would have been LOX and bagel.'"

PRESTON LERNER

UPDATE

Clean Up Your Contrails

ACCORDING TO A 1999 Intergovernmental Panel on Climate Change report, contrails constitute the second largest climate effect of aviation-specific emissions. Now, Rolls-Royce has filed a patent for a method of preventing them from forming ("Flight Lines," June/July 2007). Frank Noppel, from Britain's Cranfield University, says his research suggests that heating the condensation nuclei in an engine's exhaust plume could prevent the creation of ice crystals—and therefore contrails. At a seminar on aviation green issues held in Bristol last November, he said that electromagnetic radiation, such as microwaves, aimed behind an engine, could heat nuclei, and that "the power required could be as little as 0.1 percent of the engine power."

Benny Howard's Muscleplanes

»»» **BRUCE DICKENSON'S** devotion to the 1930s and '40s line of Howard aircraft runs deep. "I bleed Howard to the bone," he says. At age four, he was a passenger in his father's DGA-15. At age 16, he moved to the left seat, and he's logged more than 3,000 hours in it since.

The last DGA-15 came off the Howard Aircraft Corporation assembly line in 1943. Some 50 or 60 still fly today. The progenitor of the radial-engine, high-wing cabin monoplanes was Benny Howard's DGA-6, *Mr. Mulligan*, which in 1935 won both the Bendix cross-country race and the Thompson Trophy closed circuit race—the only airplane to win both

Howard DGA-21: "I'm too sexy for my wheel pants."

ROBOT ROLLOUT

NORTHROP GRUMMAN rolled out the X-47B, its unmanned combat aircraft prototype, at Air Force Plant 42 in Palmdale, California, last December. The so-called "cranked kite" design (kite-like in shape, "cranked" with wingtip extensions, which improve low-speed handling) is the size of a strike fighter—appropriate for a Navy aircraft that will perform precision strikes, enemy air-defense suppression, and surveillance. Northrop Grumman says the tail-less, low-observable aircraft will make carrier-based launches and recoveries in 2011.

Is a remake of *Top Gun* in order?



A follow-on to the X-47B naval unmanned combat air system demonstrator (above) will take on fuel in flight, all on its own, in 2013.

CHAD SLATTERY

aces in the same year.

Legend has it that Benny Howard, an intuitive design genius, developed his first airplane for a Prohibition-era bootlegger, who wanted an aircraft that was fast and had a hefty payload capacity. The buyer called the result a "damned good airplane," inspiring Howard to designate subsequent designs as DGAs. *Mr.*

Mulligan's fame spawned a commercial line, all manufactured for the military, that culminated during World War II in the DGA-15.

In 1999, Dickenson laid out on his hangar floor in Santa Paula, California, the first piece of what would become a brand-new Howard. "My goal was to build the airplane that I

believe Benny Howard would have built had he continued to build Howards," he says. He wanted *Mr. Mulligan's* speed and performance, as well as the DGA-15's handling qualities and stability.

Dickenson adapted the original *Mr. Mulligan* wing configuration, which had been replaced in later production models, and upgraded the DGA-15's 450-horsepower Pratt & Whitney Wasp engine with a modern version, one that delivers 600 hp. "I built every piece [of this airplane], or else I modified something from a -15 or another airplane," he says.

Late last year, Dickenson made his first flights. "It's a 225-mph airplane," he says, more than 50 percent faster than the DGA-15. His new Howard is designated DGA-21, the sum of DGA-6 (*Mr. Mulligan*) and -15. And the name painted on the engine cowling? *Mr. Dickenson*, of course.

MARSHALL LUMSDEN



DAVID WATSON

Getting Down in One Piece

NASA ENGINEERS are tinkering with a new way to land humans on the moon. "Apollo made it look easy," says Chiold Epp, assistant for exploration in the aeroscience and flight mechanics division at NASA's Johnson Space Center in Houston, Texas. "But they also chose to land in areas with not a lot of surface hazards."

Not this time. NASA's looking at the moon's crater-rich south pole for a place where astronauts in the new Altair craft can land.

"Shackleton Crater's a prospect," says Andrew Johnson, a robotics specialist at NASA's Jet Propulsion Laboratory in Pasadena, California. Shackleton sits largely in perpetual darkness. And the next generation of pilots won't be able to see much of the south pole. "The sun is always on the horizon," says Johnson. "There will be many shadows and we will



COURTESY VIKING AIR LIMITED



MARKUS BUTTINGER

Clockwise from top: Twin Otter Series 400, Antilles G-21 Goose, and Dornier Seastar, all priced in the multi-millions.

Hope Floats

WHAT'S WITH ALL THE SEAPLANES? In the past year, four companies have announced plans to resurrect mothballed designs or build from scratch, using composites and the latest in instrumentation. Viking Air, in British Columbia, recently completed flight testing of its \$4 million DHC-6 Twin Otter Series 400 (left), which carries 19 passengers and comes with standard landing gear, floats, or skis. Germany's Dornier Seaplane is building the \$6 million Seastar 12-passenger amphibian twin turboprop (left) in the United States. Antilles Seaplanes, in North Carolina, offers a remade eight-passenger Grumman G-21 Goose (above) for \$3 million. The New Nose Company in Arizona is touting its ClipperSpirit amphibian (not pictured) – which took shape on the drawing board as an updated Grumman Albatross – as a cargo hauler or a regional airliner that will carry nine to 15 passengers (price to be determined).



COURTESY ANTILLES SEAPLANES LLC

be landing on a tiny strip at the top of the crater."

During the braking phase of Altair's descent, current technology will compare the terrain to existing maps

from the Lunar Reconnaissance Orbiter (see "Lunar Smackdown," p. 48). The comparison will enable the Altair crew to determine precisely where they are

relative to the lunar surface and fly to the landing area. But at the one-mile mark, when the pilot pitches up to see what's below, Epp doubts NASA will have the

HEADS UP

Reel Stuff Film Festival of Aviation



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THE HALL OF FAME'S SECOND ANNUAL aviation film festival will screen rare 35-mm prints of *12 O'Clock High* (1949) and other classics and an episode of the 1958 television series "Steve Canyon." *Der Rote Baron* (The Red Baron), a 2008 German film with dialogue in English, will make its U.S. debut. The 1944 documentary *Memphis Belle: A Story of a Flying Fortress*, directed by William Wyler, will air, along with the 1990 film *Memphis Belle*, produced by Wyler's daughter.

Gregory Peck (at right) in *12 O'Clock High*.

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"It will tell the pilot where in the elevation map there are steep slopes, rocks, or craters," Johnson says. The laser and sensor act "like a camera, except that each pixel, instead of determining brightness, [shows] the range of that object from the camera."

The technology is similar to altimeters that use radar range from the surface to show the shape of the terrain, but the flash LIDAR allows for much higher resolution. "The hazards we want to detect are one foot by two by two," Johnson says. "We want to detect them from 500 meters."

According to Apollo reports, any closer than 20 feet and too much dust kicks up to allow crews and sensors to see the surface. "To get the timing, and the information to navigate to the safe landing spot," Epps says, "you have to get really accurate position and velocity before the dust becomes a problem."

From ALHAT's "three Doppler 'guns,' if you will," Johnson says, "you can measure how fast the sensor is moving in all three axes."

"This kind of technology could work virtually anywhere," Epp says. Including back here on Earth, for pilots of all varieties of aircraft.

■ ■ ■ HOLLY HICKMAN

Georgy Mosolov

TEST PILOT, MIKHOYAN EXPERIMENTAL DESIGN BUREAU

A colonel in the Soviet air force, Mosolov worked at Mikhoyan from 1953 to 1962, when a supersonic ejection from a prototype E-8 fighter effectively ended his career. In 1960, Premier Leonid Brezhnev designated him a Hero of the Soviet Union, and in 2007 he was named an honorary member of the Society of Experimental Test Pilots. Rodney Rogers and Vitaly Guzhva, faculty members at Florida's Embry-Riddle Aeronautical University, interviewed Mosolov in September 2008.

You made the first flight of 16 Russian airplanes. Any favorites?

The MiG-21. I helped engineers perfect the design. It was my "child." I was lucky enough to be at the controls when it set world speed and altitude records. We knew we had a great airplane. However, we also knew the American F-104 was very fast.

In 1954 you were flying the MiG-19, the first Soviet supersonic fighter. When you reduced throttle at Mach 1.06, a transonic control design problem caused the nose to pitch up and down. You lost over 15,000 feet of altitude in 21 seconds.

Negative G forces pushed my head against periscope bolts on the top of the canopy.

In those days we didn't wear crash helmets. The impact opened large wounds in my scalp. The pitching smashed my face into the control stick again and again, resulting in a lot of blood. During the dive, both engines quit. Before I could recover from the dive, the airplane was barely 300 feet above the trees. I started the second engine during climb out. Miraculously, the airplane held together, but an aileron bell crank had failed. I had very limited roll control, and blood on the windscreen and canopy obscured my vision. But I was still able to land the aircraft. Skill will prevail when luck is with you.

In 1959, you flew the MiG-21 to a world speed record of almost 1,500 miles per hour.

After I completed the course, the airplane was just about out of fuel. I shut the engine down and glided. It wouldn't re-start. The rules call for an ejection, but I decided to make a power-off landing.

Did the authorities call you on the carpet?

There are some things pilots agree not to talk about. We at MiG didn't publicize the situation, and the authorities apparently agreed to turn the blind eye.

After all, we had just set a world speed record, and the rules don't specify that you have to land with fuel. You just have to land where you took off. I did that.

I knew a Navy Blue Angel who tried the same thing in a Grumman F-11 Tiger and didn't make it. He was killed.

Test pilots have emotions like anyone else, though they don't always admit it. I had made 23 engine-out landings in various airplanes. So I figured I could make one more.

Read the complete interview at www.airspacemag.com.



COURTESY RODNEY O. ROGERS

Georgy Mosolov toured the National Air and Space Museum in 2007.

In the Museum

STOPS ON A TOUR THROUGH AMERICA'S HANGAR



NASA's Ethiraj Venkatapathy (left) and Betsy Pugel, and the Museum's Hanna Szczepanowska, look over Apollo heat shields.

into how they did it back in the '60s. Seeing the real thing, in three dimensions, in color, goes beyond any documentation that we have." The Garber staff also brought out pieces of charred heat shields from the earliest Apollo flights. Orion's shield may end up similar to Avcoat, or a variation called Phenolic Impregnated Carbon Ablator.

Pugel contacted Ethiraj Venkatapathy, flight system manager for the Orion Thermal Protection System's Advanced Development

Project at NASA's Ames Research Center in California. In August, Raj, as his colleagues call him, arrived at Garber with a dozen engineers from Ames, Langley Research Center in Virginia, Johnson Space Center in Houston, and Textron Inc., the Rhode Island company that now owns Avco. The engineers were led to a warehouse and presented with blackened chunks of heat shields from two unmanned, suborbital Apollo missions: AS-201, a 37-minute shot on February 26, 1966, that reached an altitude of about 300 miles and landed in the south Atlantic Ocean, and AS-202, launched on August 25 of that year, a 93-minute flight to a 700-mile altitude that traveled three-quarters of the way around the planet and landed near Wake Island in the Pacific.

Despite the fact that the engineers were wearing surgical gloves, the scene was reminiscent of kids on Christmas morning. The visitors examined the material with the curiosity of problem-solvers and the excitement of enthusiasts handling history.

Hot Commodity

THE APOLLO 11 COMMAND module *Columbia* is clearly one of the National Air and Space Museum's crown jewels. Displayed in the Milestones of Flight gallery, *Columbia* is surrounded by Charles Lindbergh's *Spirit of St. Louis*, Chuck Yeager's Bell X-1, and the North American Aviation X-15. While these aircraft hang high out of reach, *Columbia* is at ground level, and you can inspect every detail on the heat shield from just a nose away.

That's precisely what NASA engineers need to do as they plan a similar carbon-based heat shield, but one about four feet wider, for the new Orion crew exploration vehicle, which will take astronauts back to the moon. The engineers would like to handle old, proven material, and even rough some up in the lab. The heat shield on *Columbia* and those of all the manned Apollo craft are off limits, as these vehicles, displayed in museums around

the country, are national treasures.

But, as Betsy Pugel suspected, the Smithsonian doesn't throw things away. Pugel, one of the scientists on the Orion heat shield project at NASA's Goddard Space Flight Center in Maryland, and currently detailed to NASA Ames, doubles as a liaison between NASA and the Museum. Last spring she asked if there might be any Apollo heat shield material stored at the Paul E. Garber facility, the Museum's warehouse in Suitland, Maryland. The answer: four crates' worth. When she visited the warehouse in June, the collections staff pulled out an unused five- by two-foot manufacturing sample of Avcoat, the material used for Apollo. Made by contractor Avco, the sample was a glass- and quartz-reinforced epoxy injected into a hexagonal fiberglass honeycomb matrix several inches deep. "My jaw dropped," Pugel says. "It was a piece that gave us direct insight

"The shuttle tiles experience about 40 watts of thermal energy per square centimeter on the underbelly side," said Raj. "The Orion thermal protection system will experience about 1,000 watts per square centimeter"—about 25 times the heat the shuttle encounters. A lunar mission will end with a reentry that is far faster than a shuttle reentry. The lunar craft's speed will create temperatures around 10,000 degrees Kelvin—hotter than the surface of the sun—just inches in front of the shield. Raj pointed at the charred material. "We didn't know if we could revive this technology."

Collections staff shipped several pieces to Langley, where they'll be tested for their ability to withstand friction with other hard surfaces, because Orion may touch down on land.

Steve Gayle, one of the Langley engineers, shook his head in amazement at the artifacts. "You can't see some things until you pick up a piece," he said. Gayle marveled at how engineers had fashioned the shield's outer edge, or shoulder, and how the panels of metallic honeycomb substrate beneath the outer ablative material were joined to one another

Visitor Information



Family Days Celebrate African American Pioneers in Aviation on February 14 at the Museum on the National Mall. Admission is free; the event runs from 10 a.m. until 3 p.m. On March 21, learn about kites at the National Mall Building. The event runs from 10 a.m. to 3 p.m.; admission is free.



What's Up Receive regular updates on Museum events, read about artifacts, get detailed (and behind-the-scenes) exhibition information, and receive calendar listings, all by subscribing to the National Air and Space Museum's free monthly e-newsletter, *What's Up*. Sign up at www.nasm.si.edu.



Airbus Donates \$6 Million The National Air and Space Museum's Steven F. Udvar-Hazy Center has received a \$6 million donation from Airbus Americas Inc., the largest corporate gift to the Smithsonian Institution in 2008. The gift will allow the Museum to continue the second phase of the Udvar-Hazy expansion, which includes a wing containing a restoration hangar, the Museum's archives, a conservation laboratory, and a collections processing unit. In recognition of the donation, the Imax Theater at the Udvar-Hazy Center will be named the Airbus Imax Theater.

and to the stainless steel bottom of the vehicle. Though Gayle had studied engineering drawings of the old shield, he says he now better appreciates the design and manufacturing features.

"In a way," said Raj, "we are reinventing the wheel, but the wheel was perfected before." Examining the old heat shield material, he says,

"independently validates our current design." Beneath the heat shield, Orion's surface will be titanium, rather than stainless steel, to save weight, but the shield itself may turn out to be about the very same as the one used 40 years ago—welcome proof that NASA got it right the first time.

MICHAEL KLESIOUS

ARTIFACTS

Cream of the Crops

ALTHOUGH RALPH HOLSCLOW prefers to fly "first class, with a martini in my hand," as he joked to a reporter with the *Sacramento Bee*, he's spent the past 45 years around cropdusters. Holsclaw, owner of Growers Air Service of Woodland, California, donated this Grumman G 164 Ag-Cat – cleaned of all chemical residues and fully restored – to the Museum in March 2008. The aircraft type was developed in 1955, when Grumman engineers entered the cropduster market, designing an aircraft to meet the needs of an expanding agricultural community. Their design accommodated a weighty hopper, payload,



The rugged Ag-Cat offered cropdusters maneuverability and low stall speeds.

and pesticide-spraying equipment, and was able to withstand dozens of takeoffs and landings per day. When the prototypes were flown in 1957, more than 100 experienced cropdusting pilots were brought

in to evaluate the design. One of those pilots, Dick Reade, dubbed the aircraft "Ag-Cat," following Grumman's traditional feline theme. In a tribute, Reade's name is painted on this aircraft's fuselage.

Shooting Up a Shooting Star

FRESH OUT of fighter-bomber school in May 1952, I flew to Japan and caught a Douglas C-47 to my new home in South Korea: Base K-13, 35 miles south of Seoul and the home of the Eighth Fighter Bomber Wing, 35th Fighter Bomber Squadron. We were equipped with Lockheed F-80C Shooting Stars; on the other side of the field, sharing the same single runway, was the 51st Fighter Interceptor Wing, which flew North American F-86 Sabre jets.

My first flight at K-13 was a ride with an instructor pilot in a Lockheed T-33, the two-seat trainer version of the F-80. The instructor showed me around the area and took me up to the frontlines between the troops of North Korea and those of the United Nations. We returned to K-13 just as the tip tanks ran dry and shot a few touch-and-go landings. My next flight, a solo run in an F-80, was scheduled for that Sunday, right after the squadron's monthly flying safety meeting.

At the meeting, we were briefed that sometime during the previous month, the pilot of a Republic F-84 Thunderjet had had a problem with an external wing tank that wouldn't feed and could not be jettisoned. In an attempt to drain the tank of fuel, his wingman had flown under the faulty tip tank, opened his canopy, and tried to fire his handgun at the jammed tank to put holes in it to let it drain. But he had aimed too high. The 200-mph slipstream snatched the gun from his hand. (We never learned what ultimately happened to the F-84.) We were briefed on the incident because the F-80 canopy could also be opened in flight, so if one of our pilots had a bad tank, he could try the same thing. Landing with one full tip tank and one empty, or gone, was nearly impossible.

At landing speed there was not enough aileron control to ensure that you wouldn't drag the heavy tank on the runway, and a ruptured tank would spill fuel, melting the asphalt runway surface. At worst the airplane could cartwheel and crash.

After the safety meeting, I found my assigned airplane and made a preflight inspection. The crew chief had already done so before me, and a squadron flight instructor did the same right after me. Then I climbed in, cranked up the engine, taxied out, and took off on my first solo flight in Korea.

As soon as the tires left the runway, I could feel that the left wing was heavy. I had taxied and taken off using fuel from the tip tanks, but apparently the left one wasn't feeding.

The F-80's internal fuel tanks had electric fuel pumps to feed fuel to the main fuselage tank. But in the external wing tanks, compressed air, bled from

bombing range, a small island about a half-mile out in the Yellow Sea, and jettison the errant tank.

En route, I used about half the fuel in the right tip tank, so that when I jettisoned the full left tank, the right one would not grossly unbalance me.

I arrived over the range at about 10,000 feet. The tip tanks were mounted on bomb release shackles, so I set up the bomb release panel to let go of the left tip tank and hit the release button. The tank did not jettison.

I reset the switches and tried again. Nothing. I reported my lack of progress to the control tower and circled around for another try.

In addition to the electrical method of releasing the tanks, there was a handle to manually release each tip tank. On my next pass over the range, I pulled the left tip tank release handle. It still wouldn't go.

The bullet punched a hole through the near side of the tank and went out the other side. I quickly squeezed off two more rounds. Now I had six holes in the tank, and I could see fuel streaming out.

the engine compressor to the tip tanks, forced fuel through lines to the fuselage tank. I could see that the fuel cap on the left tank wasn't sealed—something three preflight inspections had missed—so air pressure could not build up in the tip tank and therefore the fuel wouldn't feed.

As soon as I sensed the left wing's heaviness, I stopped the right tip tank's fuel flow, called the control tower, and suggested that I return and land immediately while the airplane was still pretty well balanced. The officer in the tower ordered me to fly to the

Mounted on the instrument panel was a red "panic button" that, when pressed, was supposed to jettison everything on all of the bomb shackles under the wings. On my third pass over the range, I literally hit the panic button. The right tip tank jettisoned, but the left one wouldn't let go.

Now I was in a real pickle. There was no other way to get rid of the tank.

Then I remembered the briefing. I didn't have a wingman to shoot my tank, but I was wearing a shoulder holster that held my Colt .45 semi-automatic pistol. Maybe I could open



my canopy and shoot the tank.

I had a very heavy left wing, and no autopilot to help fly the airplane. Every time I took my hand off the control stick, the airplane started to roll left. I was going to have to get my pistol out of its holster, open the canopy, jack a round into the chamber (I never carried it with a round chambered so I wouldn't accidentally shoot myself in the leg), and try to shoot the tank while flying the airplane with the other hand. The tower officer kept calling me, and to answer him I had to keep hitting the microphone button on the top of the throttle. What I really needed was a third hand.

I had so much bulk on—flight jacket, parachute harness, and life jacket—that I couldn't reach across my chest with my right hand to get the gun from under my left arm. Finally, it dawned on me that I could reach the gun with my left hand. I jacked a round into the chamber, opened the canopy, and, with the gun in my right hand and flying the airplane with my

left, I tried to point the gun at the front end of the left tip tank, far enough forward so as not to hit the wing.

I pulled the trigger—and missed.

I was so anxious I forgot that a semi-automatic pistol reloads after each shot. I manually jacked another round into the chamber while ejecting a round over my shoulder.

The only way I could hit the tank was to lean down and aim along the barrel of the gun. I put my head down and sighted at the widest part of the tank and about two feet from its front.

The bullet punched a hole through the near side of the tank and went out the other side. I quickly squeezed off two more rounds. Now I had six holes in the tank, and I could see fuel streaming out.


Just as I prepared to empty the rest of the magazine into the tank, the tower officer called again. He asked how many holes I had and how many rounds I had fired. I mentally counted one that missed, one over my shoulder, and three that hit the tank. "Five," I told him. He told me to stop shooting

immediately. (I later learned that when he heard that I had hit the tank only three times out of five, he envisioned me waving the gun around wildly, spraying bullets everywhere.)

I started to put the gun back into the holster, but now it was loaded, and I could accidentally shoot myself. While I was trying to figure where I could safely stash it, I held it in my right hand—the same one holding the control stick, so the gun was pointed at the instrument panel. *Great*, I thought, *now I'll accidentally shoot the panel*. I moved the gun to my left hand, and the tower officer called again. I had to depress the microphone button on the throttle with my left hand and the gun was in the way. Finally I said *The hell with it*, opened the canopy, pointed the gun out, and fired until the clip was empty.

I spent the next 30 minutes flying around with the left wing down, letting the fuel drain out of the tip tank while slowly working my way back to the base. The tank held 165 gallons, so I hoped I could drain 150. By the time I got there, the tank was empty, and I made a normal landing.

Several years later I told this story in a letter published in the *Air Force Times* newspaper's "Stake Your Claim" column: I claimed to be the only pilot in the Air Force who shot his own airplane to correct a malfunction. No one else claimed to have also done it, so I guess I still hold that dubious distinction.

 LIEUTENANT COLONEL ALFRED (JOE) D'AMARIO, U.S. AIR FORCE (RET.)

Excerpted from *Hangar Flying*, available from www.authorhouse.com

Oldies & Oddities

FROM THE ATTIC TO THE ARCHIVES

The Bonneville Jet Wars

GENERAL ELECTRIC'S J47 AND J79 and Westinghouse's J46 turbojets were designed for America's high-flying cold war fighters and bombers. But during five weeks in the mid-1960s, they came down to Earth—taking the land-speed record from Britain and bringing it back to the United States.

The stage was Utah's otherworldly Bonneville Salt Flats. The stars were two middle-aged Midwestern brothers who refused to talk to each other, and a slick young southern California hot-rodder

that included a Lockheed engineer. The next year, Breedlove screamed across the flats at 407 mph, claiming the land-speed record. (All speeds are the average of two runs in opposite directions along the measured mile.)

In 1964, Breedlove returned to Bonneville, this time facing competition. Walt and Art Arfons worked out of adjacent junk-strewn lots in Akron, Ohio, separated by decades of estrangement. Independently, the brothers built two cars, each designed

His *Green Monster* was powered by a General Electric J79, the engine of the Lockheed F-104 Starfighter. Art got it for \$600 and rebuilt it himself after GE refused him a service manual.

One week after Art snatched the record from his brother, Breedlove took it away from Art. Trying to go even faster, Breedlove veered out of control at 500 mph, flew over a dike, and nosed into the water. Miraculously, he avoided drowning or being pulverized. Afterward, he joked, "And now for my next act, I'm going to set myself on fire." Still, Art Arfons got the last laugh: After tweaking his engine, he returned to the salt and made a 536-mph run, demoting Breedlove to number two.

In 1965, Breedlove was back, this time with a J79 in a new *Spirit of America*, dubbed *Sonic I*. Walt Arfons was back too, his *Wingfoot Express* now fitted with 25 jet-assisted-takeoff rockets. Although they propelled Arfons' car to more than 400 mph, they couldn't sustain that speed long enough for Arfons to challenge the record. But Breedlove clicked off a run of 555 mph to become the fastest man on wheels.

A week later, Art Arfons strapped himself back in *Green Monster*. During his second pass, a tire shred, but he emerged from the cockpit of his dented and smoking car with another record: 576 mph. A few days later, Breedlove went 600.601 mph, and he was immortalized in the Beach Boys song "Spirit of America" as "a daring young man [who] played a dangerous game."

Cars have gone faster: In 1997, a British team broke the sound barrier with a speed of 763 mph, powered by two Rolls-Royce Spey turbofans, which powered F-4M Phantom IIs. But land-speed racing has never been hotter than when cold war turbines were the coolest things at Bonneville.

PRESTON LERNER



who'd talk to anybody. By the time it was over, the three had raised the top speed by nearly 200 mph.

The jet-powered land-speed wars erupted in 1962, when three streamlined cars built around J47s—the engines used in North American F-86 Sabres—appeared on the flats. Physician Nathan Ostich, builder of the first jet car, took *Flying Caduceus* to 331 mph. Glenn Leasher got close to 400 mph but crashed fatally.

The third J47 driver, Los Angeles drag racer Craig Breedlove, picked up his engine for \$500 and installed it in a low-slung, needle-nose chassis he called *Spirit of America*. He lined up Shell and Goodyear as sponsors and hired a team

Craig Breedlove's turbojet-powered racer reached 600 mph in November 1965.

around a different jet engine.

Walt opted for a Westinghouse J46, used in the Vought F7U Cutlass. Although the Navy fighter was a dud, its engine measured up to Breedlove's J47, and surplus versions were available for next to nothing. When his *Wingfoot Express* crashed during testing, Walt had a heart attack. Designer Tom Green, who'd never driven over 130 mph, was drafted as driver. On October 2, he reached 413 mph to claim the record.

Three days later, the newly crowned speed kings learned that their record had just been broken—by Art Arfons.



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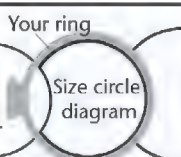
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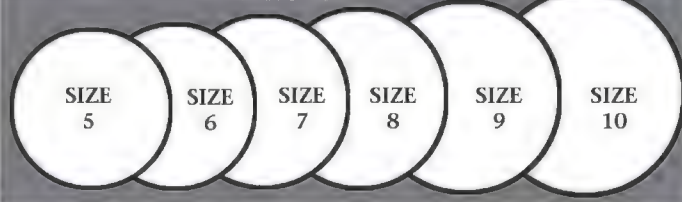
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WOMEN'S SIZES



A silhouette of a person stands against a dramatic sunset sky with streaks of light. The person is positioned on the right side of the frame, looking out over a body of water. The overall mood is contemplative and adventurous.

LICENSE *to* THRILL

DO YOU HAVE WHAT IT TAKES TO
FLY A ROCKETSHIP?



BY MICHAEL BELFIORE

PHOTOGRAPHS BY CHAD SLATTERY

IN THE OLD DAYS it was straightforward enough. The planet had two corps of astronauts, Soviet and U.S., and to join one, you had to be a military test pilot. But now the rules have changed. You don't have to be an American or a Russian anymore, and you don't even have to be a government employee.

In 2004, Burt Rutan and his small company in Mojave, California, Scaled Composites, broke the government monopoly on human spaceflight. The company built *SpaceShipOne* using the same carbon fiber molding techniques used by airplane homebuilders everywhere, at the ridiculously paltry cost of \$25 million. At the controls on its first flight into space sat not a steely-eyed missile man forged in the cold war but a 63-year-old high school dropout from South Africa. "I'm just a guy," Mike Melvill exulted after *SpaceShipOne's* inaugural flight into space. "An *old* guy!" The implication was inescapable. If *he* could drive a spaceship, so could anyone.

Of course, Melvill wasn't just any guy. He had spent the previous 25 years studying at the school of experience, flying one quirky experimental airplane after another. During his tenure with Scaled and its predecessor company, Melvill had made the first flights in nine other airplanes, among them the California Microwave, a reconnaissance aircraft designed to fly equally well with a pilot or without; and a self-powered sailplane called the Solitaire, with a propeller and engine that could retract into the fuselage to reduce drag.

SpaceShipOne's next pilot, Scottish-American Brian Binnie (see "Confessions of a Spaceship Pilot," June/July 2005), followed a more traditional route to space. As a boy, Binnie had been inspired by the Apollo moon landings to aim for the stars himself. Alas, after aerospace engineering school at Brown University in Rhode Island, test pilot training at the Navy air station in Patuxent River, Maryland, and 20 years as a Navy pilot, he found that a career at NASA was not in the cards. But by the time he retired from

The hotshot pilots who will fly the first generation of space tourists on their pricey jaunts will follow in the footsteps of Scaled Composites' Mike Melvill, Peter Siebold, and Brian Binnie (left to right).

the Navy, in the late 1990s, another option had opened: commercial spaceflight. The first Mojave space startup Binnie joined, Rotary Rocket, went bust before reaching space, but by then he had made the acquaintance of Burt Rutan (Scaled Composites had been a contractor for Rotary). Rutan needed pilot-engineers, and Binnie signed on.

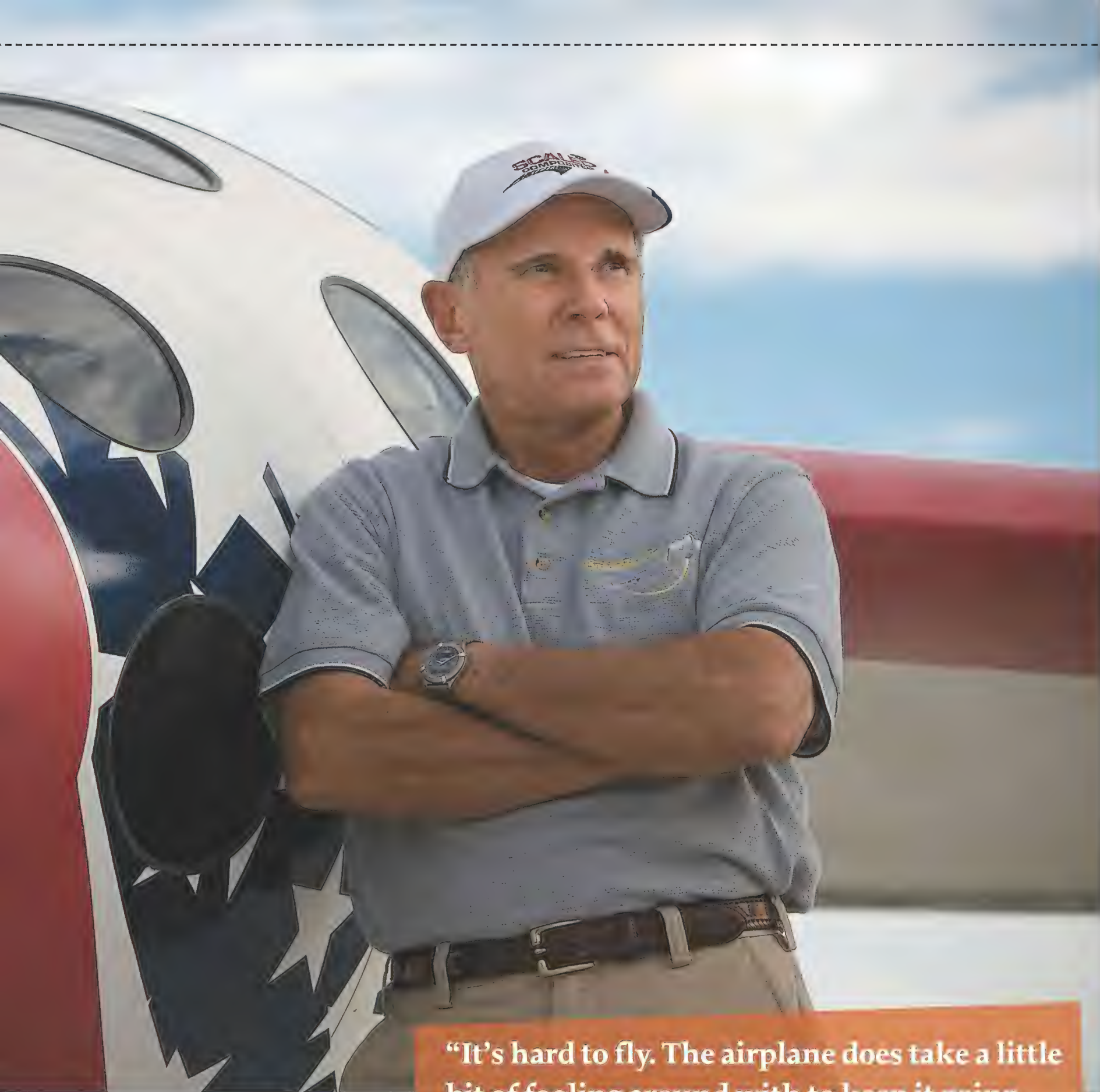
The engineers and dreamers had known all along that private enterprise could send people into space, and after *SpaceShipOne* made three spaceflights in 2004, the financiers knew it too. Sir

Binnie (below) had military test-pilot expertise; Siebold (bottom) had the aeronautical engineering chops; Melvill (right) had mastered the experimental fringe.



Richard Branson, the British airline tycoon who had dreamed of space since seeing the 1968 movie *Barbarella*, had registered the name “Virgin Galactic” in 1999, and in *SpaceShipOne*’s design he finally saw a ship worthy of the name. Now Virgin Galactic is racing to be the first company to put paying passengers into space—six at a time with the Scaled-designed, corporate-jet-size *SpaceShipTwo*. Virgin has already sold more than \$20 million in tickets for rides on *SpaceShipTwo*, which it plans to begin flying next year. Like its smaller predecessor, the spaceplane will drop from a jet-powered mothership at an altitude of 50,000 feet, where the pilot—this time assisted by a copilot—will fire a hybrid rocket motor and pull back on a stick to pitch up for a 3- to 4-G, Mach 3-plus run out of the atmosphere, and then four or five minutes of weightless flight in space.

That’s right, a stick. Like its predecessor, *SpaceShipTwo* will feature no computer controls, not even a fly-by-wire system.



“It’s hard to fly. The airplane does take a little bit of fooling around with to keep it going straight. You’re working rudder pedals, you’re working stick, you’re working trim.”

—MIKE MELVILL, TEST PILOT FOR SCALED COMPOSITES

The pilot will have to wrestle the ship through its boost phase and possible off-center thrust (caused by a tendency for the rocket motor’s solid fuel to burn unevenly), using manual controls attached by rods and cables directly to the rudder and elevons. Those control surfaces will become immovable when the ship transitions through supersonic flight, at which point the pilot will have to keep the ship on course with electrically operated trim controls. Even those will become increasingly ineffective as the air around the ship thins to nothingness, at which point only the reaction control system’s bottles of compressed air will enable the pilot to change the ship’s orientation. “It’s hard to fly,” Melvill said at a 2005 talk of piloting *SpaceShipOne*. “The airplane does take a little bit of fooling around with to keep it going straight. You’re work-

ing rudder pedals, you’re working stick, you’re working trim.” The spaceship’s all-carbon-fiber construction lacks the strength to survive sustained supersonic flight in the atmosphere, making the pitch-up maneuver mandatory. “If you did not make the turn and you kept flying level, it would come apart,” said Melvill. “The dynamic loads on the vehicle would be so high, it would crush like an eggshell.”

To stay on course, the pilot will rely on a screen displaying the ship’s trajectory superimposed on the ideal flight path. “Nor-

Virgin Galactic's David Mackay, standing in *SpaceShipTwo's* mothership, has experience in 100-plus aircraft types.

mally our display works very well, and you just keep the green circle around the red circle," said Melvill. "But on one of my flights the display went out, and so I had to [resort] to looking out of the windows." With help from mission control, this was not as difficult as it sounds, said Melvill, "because I was able to see the horizon out of the corners of my eyes through two of the side windows. By keeping these horizons equal, I was able to maintain vertical flight."

After coasting through an apogee of 360,000 feet, well past the 62-mile Kármán line demarcating space, *SpaceShipTwo* will reenter the atmosphere. The ship's hinged tail booms, devised by Rutan to swing upward while in space and to automatically right and slow the ship as it reenters, will leave the pilot with little to do but strain to stay conscious during the 6-G deceleration. After lowering the ship's tail by pushing forward a lever located between the pilot's and copilot's seats, the pilot will glide the spaceship back to a dead stick landing at the airport from which he had taken off some two and a half hours earlier.

Virgin has already begun recruiting spaceship pilots from among the commercial jet pilots of its four airlines. With the rules of the game still being written, the only stated requirements for a Virgin space pilot is 3,000 hours of flying time and ratings on multiple aircraft types. There are no weight, height, or other physical requirements. "Obviously, pilots will have to be healthy and fit," says Virgin Galactic test pilot and Virgin Atlantic captain David Mackay, "but not necessarily more so than, say, military fast-jet pilots." Ostensibly that qualifies all of Virgin America's pilots, who all have twice the required number of hours. But it's no accident that those on the short list have a lot of additional relevant experience.

Take Virgin America captains Rob Bendall, 44, and Rich Dan-
caster, 55. These two civilian-trained test pilots made the flights the Federal Aviation Administration required to get Virgin America certified. Bendall is a good-natured Canadian with dark brown hair and a quick smile who clearly loves his day job. Virgin America's chief pilot, he has seven years of flight test expe-

rience with Nevada-based International Flight Test Group, as well as flying time in everything from small airplanes like Cessnas and Pipers to the big Airbus transports he pilots for a living.

Dancaster, Virgin America's director of pilot training, grins when asked why he wants to be a spaceship pilot. "Once they said you go from like Mach .7 to about Mach 4 in 10 seconds, I said 'I gotta try that!'" Dancaster, whose flying experience encompasses a broad range of aircraft, including the Boeing 747, the Airbus A320, and the Douglas DC-8, is fit and trim with close-cropped gray hair. He exudes the kind of quiet competence that passengers on the first commercial spaceflights will doubtless find reassuring. Bendall and Dancaster are, in fact, counting on their obvious competence to put potentially anx-



Virgin America pilots Rich Dancaster, Rob Bendall, and Brad Lambert bring the quiet competence of airline captains to the job.

ious passengers at ease during preflight briefings and during the flight to launch altitude. If necessary, the pilots might be able to get out of their seats to help spacesick passengers back into their seats before reentry, but once the spacecraft begins the 6-G reentry, a passenger having a hard time will have to cope on his own. Virgin Galactic hopes that centrifuge training will nip such problems in the bud.

Bendall, Dancaster, and fellow Virgin America pilot Brad Lambert will each spend 27 months on loan from their airline to train with Virgin Galactic. As we went to press, they hadn't yet started their training—which will include flying simulators at Scaled—and so weren't able to compare the spaceship's handling characteristics to those of more conventional aircraft. But Virgin Galactic test pilot Mackay, who is already working with the pilots and engineers at Scaled, has had a taste of what the Virgin Galactic pilots are in for. "The obvious differences here to anything I've flown in the past," he says, "are that [the ship] goes much faster, much higher, and into a new environment." With structural changes made to the design after the flights of *SpaceShipOne*—mainly bringing the wings from atop the fuselage to below it to increase stability—the ship shouldn't be quite as difficult to fly during the boost phase as its predecessor. "The change in the vehicle's responses to disturbances or control inputs as it rapidly travels through the atmosphere makes it interesting," says Mackay, "but, in practice, the boosted flight profile is quite simple." As for gliding it home, he says, "in the landing pattern SS2 is quite agile, its field of view is good, and it has an excellent, versatile navigation system, meaning that,

British tycoon Sir Richard Branson (left) and maverick aerospace designer Burt Rutan are racing to put the first paying passengers into space – at \$200,000 per 2 1/2-hour flight.



MICHAEL BELFIORE

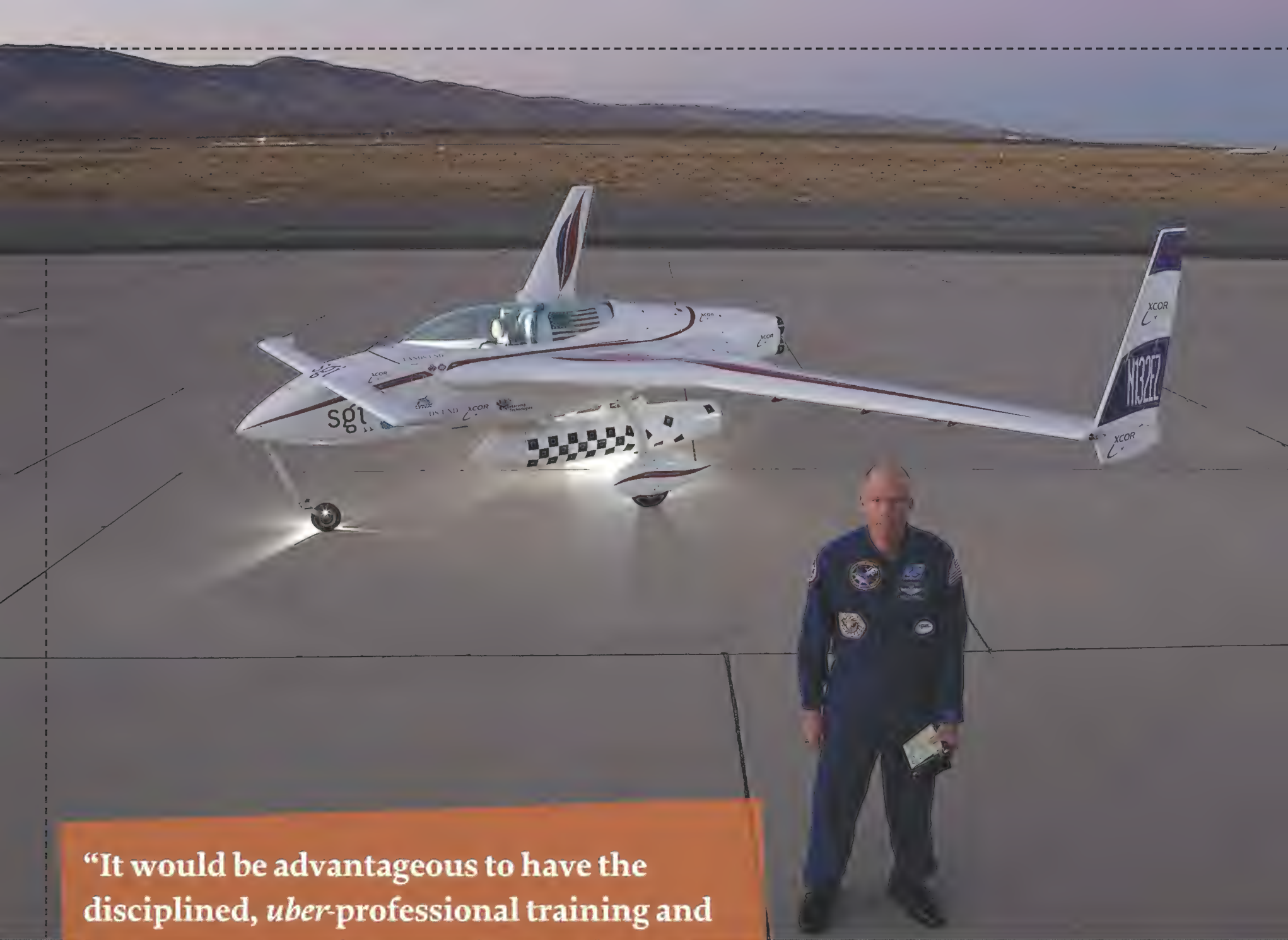


Rich Dancaster grins when asked about his motivations for wanting to be a spaceship pilot. "Once they said you go from Mach .7 to Mach 4 in 10 seconds, I said, 'I gotta try that!' "

if necessary, pilots can be quite flexible in the approach they fly. I've flown flameout patterns in the AV-8B [Harrier jump jet] and Mirage III [fighter] and they were more demanding."

Mackay came to Virgin in 1995 after serving in the Royal Air Force as a test pilot, most recently as chief fixed-wing instructor at the Empire Test Pilots' School in Wiltshire, England. All told, he has more than 11,000 hours of experience in 100-plus aircraft types, including World War I biplanes, early jets like the de Havilland Vampire, and, of course, the airliners he flies now. Like Binnie, Mackay was inspired to become an astronaut by Apollo. "The only snag in my plan was that the U.K. was not sending people into space," he says. It wasn't until he reached his 30s that he realized he probably wouldn't become an astronaut. "That was hard to accept," he admits. So when Virgin and Scaled Composites offered a chance to become a commercial spaceship pilot, he jumped. Besides working closely with Scaled pilots Binnie and Pete Siebold (Melvill has retired from full-time duties at Scaled) in creating the flight test program, Mackay is helping to work out the training program for the Virgin pilots who will follow him into space.

As Mackay puts it, "The accuracy of the flight profile and the safety of the vehicle rest entirely in the hands and the flying skills of the pilot," so future space pilots will need to spend time—lots of it—in Scaled's spaceship simulator. But in preparing a pilot for the demands of flying a spaceship, the simulator can go only so far. Training will also include flying time in the *White Knight 2*, which has deliberately been designed with a cockpit identical to that of its daughter ship, as well as with the ability to duplicate the lift-to-drag ratio of a spaceship gliding to a landing. And, says Mackay, "all *SpaceShip* pilots will



“It would be advantageous to have the disciplined, *uber*-professional training and background as a former military pilot for any commercial spaceflight operations.”

—RICK SEARFOSS, CHIEF TEST PILOT FOR XCOR AEROSPACE

Rick Searfoss, former space shuttle commander, now XCOR's chief test pilot, has helped make the desert town of Mojave the world capital of civilian manned rocket vehicle flight.

have to be in current practice in high-G maneuvers.” Mackay and his colleagues envision flying in aerobatic aircraft such as the Extra 300, in which the *SpaceShipOne* pilots trained. Weightless flight training is possible in conventional aircraft too, says Mackay, but “as *SpaceShip* pilots will remain strapped in throughout the flight, it is not currently as important as high-G training.”

If all goes well, Virgin Galactic expects to fly at least two spaceflights a day from each spaceport from which it operates—initially New Mexico’s Spaceport America, and then from other locations around the world. Since each flight will require four pilots—two in the spaceship and two in the mothership—the initial cadre of 18 pilots will get a lot of flying time.

Wanting to experience some of what a pilot (and passengers) will go through on a *SpaceShipTwo* flight, I visited the National AeroSpace Training and Research Center in Southampton, Pennsylvania. The NASTAR center has configured a centrifuge to exactly duplicate the G-loads of a *SpaceShipTwo* flight. The center’s parent company, the Environmental Tectonics Corporation, manufactures centrifuges, altitude chambers, and other flight simulation equipment, and it launched NASTAR in October

2007 to train fighter pilots as well as potential commercial astronauts. After checking out the facility, Virgin Galactic officials contracted with NASTAR in September 2007 for preferential treatment and pricing for Virgin Galactic passengers. “We worked very closely with the VG team to provide a complete VG branded experience,” explains NASTAR chief operating officer and instructor Glenn King. “This experience includes flights in our High Performance Human Centrifuge, now called our STS-400 [Space Training System], with the flight profile matched to the actual VG suborbital flight profile.”

The NASTAR center is the only non-government-operated facility in the world where civilians can undergo high-G training. I signed on for the center’s one-day “spaceflight lite” program, which subjected me to only half of the maximum G-loads of a *SpaceShipTwo* flight. The full-G, two-day program that Virgin Galactic offers as part of the price for a rocketship ride would have cost \$5,800 and required a flight physical as well as an ambulance on standby at the center. Still, the light version was enough to give me a sense of what spaceflight would subject me to. After Brienna Henwood, director of commercial business, strapped me into the capsule—complete with projected

A passenger on XCOR's *Lynx* will ride up front, next to the pilot, "instead of in back, like cargo," says Searfoss, here in a cockpit mockup.

images of altimeter, G-load, and Mach number gauges and a simulated view out the front and back of the spaceship—and secured the hatch behind me, an automated voice provided a countdown from the control room. The reassuringly professional voice talked me through the drop from the mothership (accompanied by a gentle rocking of the capsule), and then the rapid buildup of Gs as the rocket motor fired. As instructed by King in a classroom earlier, I tensed my legs and forced air through pursed lips to blow away the grayness creeping in on the fringes of my vision as the blood tried to drain from my brain.

King had shown me and a fellow student a video of himself in the fighter cockpit mockup, undergoing gravity-induced loss of consciousness. It wasn't pretty. His eyes rolled back in his head, his head flopped forward, and his hand fell from the control stick in the centrifuge. Granted, at that point he was up to 9 Gs, but even *SpaceShipTwo's* 6 Gs could knock out a pilot who doesn't start proper breathing and straining maneuvers to keep the blood in his head well in advance of the high Gs. King explained that once the blood has drained from your head, it's extremely difficult, if not impossible, to force it back up your neck. For commercial space pilots, high-G training will be essential.

To all the other qualifications of a commercial spaceship pilot, one might add that of company spokesperson. Former Air Force test pilot and NASA space shuttle commander Rick Searfoss is now chief test pilot for XCOR Aerospace, yet another spaceflight startup based at the Mojave Airport. He puts his experience as a professional speaker to good use during XCOR press conferences and public events like the rocket-powered

The NASTAR center's centrifuge duplicates the G-loads of a *SpaceShipTwo* flight. Chief instructor Glenn King holds the world's record for most hours spent inside a "vomit comet."



MICHAEL BELFIORE



airplane flights he made last summer for XCOR and the Rocket Racing League at the Experimental Aircraft Association's annual Oshkosh, Wisconsin fly-in. Commercial space pilots will necessarily become some of their companies' most visible representatives in selling the experience of spaceflight to potential passengers. Regarding a space pilot's more formal qualifications, "obviously I'm showing my bias here," says Searfoss, "but I believe it would be advantageous to have the disciplined, *uber*-professional training and background of a former military pilot, particularly a formal-course graduate test pilot, for any commercial spaceflight operations."

XCOR's planned one-pilot, one-passenger, jet-fighter-size suborbital rocketplane, called *Lynx*, will glide through its descent, since none of the craft's kerosene fuel will remain after the boost to space. *Lynx* will take off on its own from a runway and reach an altitude of about 200,000 feet. Although the craft is still under construction, Searfoss has flown XCOR's rocket-powered technology demonstrators. "Imagine a small, light, experimental homebuilt like a Long-EZ, which flies very nicely to begin with," he says. "It has light stick forces. It's a nice flying airplane if you're a fighter pilot. But then without a reciprocating engine...it's just smooth as silk to fly."

Searfoss says piloting a rocketplane is "all very much the case of just managing your energy." With no fuel left in the tanks for a landing, says Searfoss, "it's just a question of doing exactly what glider pilots do, exactly what a shuttle commander does...to just position yourself to get to the endgame: stopped on the runway safe and sound."

So far, XCOR's space pilot corps is a one-man show, but the company anticipates hiring more pilots after Searfoss flies the first *Lynx* flight tests to space, which it hopes will take place by next year. "We have a few in mind, not at liberty to say who, but they have military backgrounds as well," says Searfoss. He and his colleagues haven't yet worked out a program for training new pilots, but it will most likely include high-G training in acrobatic aircraft and time in XCOR-built simulators. There will not be much, if any, zero-G time.

As for me, I can breathe and strain with the best of them, but I'll leave the piloting to the professionals. Besides, when I hit zero G, I want to be free to move about the cabin. ➤

Woe Canada

**ANOTHER EXAMPLE OF CANADIAN AERONAUTICAL GENIUS THAT NEVER
MADE IT TO THE PRODUCTION LINE.** by Graham Chandler



THERMOMETERS WERE NUDGING 100 at Malton Airport in Toronto, Canada, when North America's first jet airliner lifted off in a stiff crosswind. The aircraft flew for 65 minutes that day, August 10, 1949, just two weeks after Britain's Comet jetliner had become the world's first and five years before the United States would fly its first, the Boeing 707.

The Avro Canada C102 Jetliner could out-climb and out-cruise any airliner on North American drawing boards. It also needed less runway than anything the airlines had in their fleets and could fly higher, faster, and, a cost analysis later found, cheaper. The airplane was coveted by at least six airlines, the U.S. Air Force and Navy, the U.S. Civil Aviation Authority, and even billionaire Howard Hughes. Yet despite all the interest, seven years later the jet was put to the cutting torches. Its nose section sits forlornly at the Canada Aviation Museum in Ottawa, and the rest of the pieces were long ago sold to an Ontario scrap dealer.

What happened?

When World War II ended, Avro Canada

was an independently managed subsidiary of British-based Hawker-Siddeley Group and, capitalizing on former wartime talent and labor, soon had several advanced designs under way. By the end of the 1950s, Avro had created not only the first North American jet airliner, but also an exceptionally capable Mach 2 interceptor, the CF-105 Arrow. Both fell to the fickle politics of national defense (see "Fallen Arrow," Apr./May 1998). Avro's greatest success was the CF-100, the Canadian North American Air Defense Command (NORAD) during the cold war to protect North American airspace from Soviet intruders. More than 700 were sold to the air forces of Canada and Belgium.

"It was a heady place to work," recalls Jim Floyd, now 94. "It was a brand-new company. There were so many exciting things going on there." At 32, the Manchester-born engineer reported for work at Avro Canada on February 11, 1946, and began organizing a new technical department. By the end of the month, the forward-thinking group was ready to discuss a new proposal: to design and produce a 30-passenger jet for Trans-Canada Airlines (now Air Canada) that could operate from 4,000-foot-long runways, could cruise at 400 mph, and had a 1,200-mile

range. The group proposed the C102, and TCA was impressed. By April 9 the airline had sent Avro a letter of intent to purchase "a quantity" of the aircraft.

Back then, jet airliners were pie-in-the-sky ideas. Designing one was more than just mounting jets in place of piston engines. Because a jet becomes efficient at much higher altitudes and airspeeds, entirely new configurations were required, ones that could be controlled over a wide range of speeds and had fuselages able to withstand constant pressurization changes.

Floyd looked even further ahead than the TCA spec. "We decided from the outset...to allow for future development of the type," he wrote in his book *The Avro Canada C102 Jetliner*. The team was hoping eventually to attain cruise speeds of 425 to 450 mph with a 40- to 50-passenger range of 1,500 miles. Floyd had the ideal engines in mind—two newly designed Rolls-Royce AJ65s, with 6,500 pounds of thrust each—but since those were still restricted to the military, he had to settle for four tried-and-true Rolls-Royce Derwent V engines. In 1945 Derwents had powered Britain's Gloucester Meteor fighter to a world record of 606 mph. The four engines gave the Jetliner more thrust but also increased the airplane's fuel consumption 13 percent.

TCA expressed cautious interest in the Jetliner. But the airline had enough on its plate with getting its new North Star (a Canadian variant of the Douglas C-54/DC-4/DC-6 with Rolls-Royce Merlin V-12 engines) into service and making sure TCA could fill the seats.

"The reality was that the high traffic levels of the early 1940s were artificially inflated by wartime demands, and Canadians were not yet reconciled to flying as the normal way of getting from place to place," says Jonathan Vance, Canada Research Chair in History at the University of Western Ontario. As a result, the airline struggled with budget deficits in the postwar years. "When it came time to up-

Canadian newspapers trumpeted the glories of the Avro C102 Jetliner (opposite), which made its first flight in 1949 at Malton Airport in Toronto. The airplane was featured briefly in an Avro pamphlet (left), which called it "an efficient and beautiful aircraft which we hope will be in great demand."



grade the fleet, there was a fundamental question: Do you do it with a supposedly better version of an aircraft that the traveling public is already familiar with—i.e., a prop-driven aircraft—or do you do it with something new and different? If I had been with TCA at the time, I would have avoided jet technology.”

In 1948, TCA’s new president Gordon McGregor did just that: Floyd’s book reports that at a meeting shortly after his appointment, McGregor said he didn’t want the airline to be the first in North America to operate a jet transport. Management began to look for escapes: Since few Canadian airports had the new Instrument Landing Systems that would enable the new aircraft to land, TCA pointed out that the Jetliner would require considerably higher fuel reserves to get to those airports with the necessary equipment. TCA also demanded more stringent specifications, like a 500-mph cruising speed, which would have required a complete redesign to accommodate a swept wing, like the Comet had. “It would have been easier to convert a cow into a crocodile than it would have been to incorporate all TCA’s new ‘suggestions’ into the C102 design,” writes Floyd, who points out that unlike the long-range Comet, the Jetliner was optimized for short- to medium-length routes and the ability to operate from shorter runways.

As TCA dithered, Floyd looked for customers elsewhere, especially south of the border, where airlines traditionally worked closely with designers. But in 1947, U.S. airplane manufacturers Douglas, Lockheed, Martin, Convair, and Boeing all posted financial losses and were preoccupied with new piston designs like the DC-6, Constellation, Martinliner, Convairliner, and Stratocruiser. Years later, Boeing unveiled its 707 prototype, heralding a new jet intended for longer-range, intercontinental travel. The Avro Jetliner, by contrast, had been designed as a regional jet.

Workers install an engine in the Jetliner (above), which served as the backdrop for promotional photos (right and opposite). Opposite, far right (left to right): Avro designer Jim Floyd, pilot Jimmy Orrell, flight engineer Bill Baker, pilot Don Rogers, production official Henry Garside (hidden), and vice president Walter Deisher.

Still, U.S. interest in Avro’s work was high. “In the Avro XC-102, the Dominion of Canada has something brand new in the commercial transport field—a 100 per cent jet-powered design with an economical cruising speed 100 mph faster than the newest American types,” reported *Aviation Week* magazine on November 1, 1948.

So Floyd and his team pressed on, dedicated to making the Jetliner a success. Despite the loss of key staff to the CF-100 program, morale at Avro was soaring. Engineers, draftsmen, and technicians worked on the project well into the nights, and in the summer of 1949, the Jetliner flew without a hitch. Flight testing went smoothly into the fall.

Soon a second prototype was under construction. But with no firm customer base, what was there to design to? Sales pitches to the United States were stepped up, as “the American market is wide open” for the jetliner, Delos W. Rentzel of the U.S. Civil Aeronautics Administration told Canada’s national news magazine, *Maclean’s*, in late 1949.

On March 10, 1950, the Jetliner, along with the new CF-100, was flown to Ottawa to show off to government officials, military leaders, and dignitaries. The show was impressive; Toronto’s *Globe and Mail*

reported “the big Jetliner’s performance evoked whistles of amazement.”

To keep the ball rolling, Avro invited TCA’s McGregor along on a flashy marketing and demo trip to New York. On April 18, the Jetliner made what was probably the most widely publicized airliner flight in North American history: leaving Toronto and blowing into New York City 59 minutes later. Scores of newspapers, including the *New York Times*, carried headlines like “Canadian Jet Liner Makes Air History” and “Jet Airliner Cuts Flying Time in Half.” Recognizing Canada’s huge jump on U.S. airline manufacturers, some U.S. newspapers blasted the lagging state of the American industry.

The tour set the industry abuzz. TCA warmed a little, sending their operations manager and their chief test pilot for flights. Dixon Speas, assistant to the president of American Airlines, defected to Avro to head up a new marketing office in New York. He began calling on Capital, United, National, American, Eastern, and TWA airlines, as well as the U.S. Navy. National discussed a contract to purchase four Jetliners with an option for six more.



See Airlines Of World Beating Path To Avro

“JUST PIECE OF CAKE”
VETERAN CALLS TRIAL

By ALBERT TURNER
Telegram Aviation Reporter

“She flies like a fighter!”
That’s the assessment of Canada’s
Jetliner as made by James Orrell,
Britain’s topflight test pilot, who
came from Avro Manchester to take
the maiden flight of the four-
engine Avro Canada

“It was perfect—the
fastest, everything
the letter,” he said.

HUGE EXHAUS

Bill Baker also
of the quiet flight
which makes him
more than a Vamp



The second Jetliner would incorporate the airline's requirements: longer fuselage for 60 passengers, increased range, double-slotted flaps, and a provision for whatever engine a customer wanted.

Meanwhile, the Air Transport Board released a study of the TCA route. The board said that running the Jetliner on the popular Toronto-Montreal-New York route, despite each leg being well short of the Jetliner's design range, would be 20 percent cheaper than using North Stars. Not only that, the Jetliner could do the routes in two-thirds the time with three airplanes—one fewer than the number of North Stars required. And, the board wrote, as the lengths of the legs along a route grew, costs would improve, producing even greater net revenues.

So by mid-July 1950, less than a year after its first flight, the prospects for the Jetliner looked bright. But 1950 was another war year: Korea. The United States and Canada were gearing up in case it escalated into a wider conflict. Avro was committing more workers and nearly all of its space to CF-100 production. Avro's commitment soon grew to 720 CF-100s—

25 a month—and the second Jetliner was squeezed into a hangar corner.

Floyd pressed on. Through early 1951 several demonstrations were run carrying airline executives as far south as Miami and as far west as Los Angeles, confounding air traffic controllers along the way as they reported unheard-of airliner speeds and altitudes. Even the U.S. Air Force got into the picture, inviting the Avro team to come to Wright Field in Dayton, Ohio. With its high speed and cruise altitude, the Jetliner was the closest thing out there to the new bombers, so the Air Force thought the airplane would make the ideal crew training platform.

But the priority both nations put on building warplanes was leading to the Jetliner's demise.

ONE HUNDRED YEARS AGO, Clarence Decatur Howe left the land his ancestors settled in the 1630s near Waltham, Massachusetts, and crossed the Canadian border to take his first job: professor of civil engineering at Halifax's Dalhousie University. By 1935, he was a member of Par-

liament, and soon after rose to become Canada's wartime Minister of Munitions and Supply. A go-getter, he was dubbed in 1947 "our new dictator" by an opposition member when Howe got a new cabinet post as the country's first Minister of Transport. From there, he would drive the final nails in the Jetliner's coffin.

Although Howe oversaw TCA, he never warmed to the Jetliner. With the overwhelming CF-100 commitment, he ordered Avro to withdraw the airliner from consideration by National, end promotions to other U.S. airlines, and stop work on a second aircraft. Floyd continued courting U.S. Air Force interest, and had the jet flown to the Wright Air Development Center for a thorough trial by Air Force engineers, pilots, bombardiers, and maintenance crews. A month later, they submitted a report card: eminently suitable as a multi-jet-engine trainer for pilots and bombardiers, with a bonus idea—air refueling tanker. Speas heard from the sales manager for the Allison division of General Motors, who said the Air Force told him it had put aside \$20 million to buy 20 Jetliners; according to Floyd's book,





the U.S. Navy was also interested.

But back home at Malton, all was not so rosy. The second CF-100 prototype had crashed, and production of the fighter and its engines was way behind schedule. Avro management continued to shift workers from the jetliner to the fighter program, and transferred Floyd's chief aerodynamicist to a new, secret, all-weather, supersonic interceptor project to replace the CF-100; the interceptor would evolve into the Arrow. Floyd's team didn't even have the manpower to engineer the installation of the Allison J33 engines the Air Force wanted. Worse, Floyd himself was asked to leave the Jetliner project to troubleshoot the fighter production line—"not the happiest period of my career," he wrote. Twisting the knife was a visit to the plant by Howe, who told Floyd, "I suggest you forget that airplane and put your energy into

getting the CF-100s out." Soon afterward, a senior civil servant named Crawford Gordon, who had worked under Howe, was made Avro's president.

Ironically, it was the CF-100 work that spawned a potential revival for the Jetliner. Avro was proposing to use the Hughes MG2 fire control system for the Mark IV version of the CF-100. In a 2005 interview, Floyd told me: "Crawford Gordon got the idea that Howard Hughes is good for new projects, and so why don't we get him interested in the Jetliner?" The idea was that the Jetliner would make a good flying testbed for the fighter program. "The Jetliner was nearly as fast as a CF-100, so we could put all the equipment in there and try it out," Floyd said. Hughes was well aware of the record-breaking Jetliner—his airline TWA had already evaluated it, and he was anxious to fly it.

So on April 7, 1952, the Jetliner departed Malton for Culver City, California. Among those on board were Floyd, who brought along reams of Jetliner drawings, and chief test pilot Don Rogers. After stops for fuel in Chicago and Denver, the crew arrived at Hughes' airfield the following afternoon. The next day, the billionaire arranged to meet them at their airplane.

"My first impression was: Here was someone who was almost, what shall we say, a phantom," Floyd told me. "He drove up in a car, and stayed in the car about two hours talking to somebody." Finally the car door opened and Hughes walked over to meet the team. He had a quick look inside, and seemed especially interested in the cockpit layout.

The next day, Hughes wanted to fly. Rogers sat him in the copilot's seat. "He didn't say very much," Rogers told me in



Even though the rugged airplane had survived an emergency nosewheel landing on its second test flight, the Jetliner's days were numbered. Not even interest from Howard Hughes (opposite, top) was enough to save it. Instead, Avro ramped up production of its CF-100 fighters (left).

renowned Hollywood party life with the ever-present starlets, Hughes made a proposal for Convair to manufacture 20 or 50 Jetliners under license for TWA's more prestigious routes. Convair completed detailed plans that summer to deliver the first airplane by May 1954. Some say Howe intervened to quash the deal, but historian Jonathan Vance isn't so sure. "I suspect it was equal parts economic nationalism and a kind of tit-for-tat because the U.S. had put restrictions on out-of-country, defense-related manufacturing," he says. The Convair license from Avro would certainly have qualified as "out-of-country" manufacturing. Floyd said the plan was killed when the U.S. government decided that its own military commitments must take priority in Convair's plants.

Hughes' final attempt was offering to finance Avro to build him 30 Jetliners. Howe would have no part of that. According to Floyd's book, Howe wrote to Avro, "...any such use of your floor space cannot be tolerated." The Hughes MG2 fire control system never did get installed, and Rogers was told to bring the airplane back to Toronto.

For the next few years the Jetliner became Avro's house airplane, photographing CF-100 weapons tests or pilot ejection tests. But before long, the lack of spares and the long-term maintenance issues made the Jetliner increasingly useless.

On November 23, 1956, Rogers signed out the Jetliner and took off with three passengers for a 35-minute hop out of Malton. It was his only trip that day, and before he left the office, he sat at his desk and made his logbook entry. Seventeen days later Floyd received an interoffice memo from Avro's president, ordering with great regret that "the Jetliner is to be dismantled, in an appropriate fashion, as quickly and as quietly as can be done, every precaution being taken to attract as little attention as possible, and with the avoidance of any fanfare." That day, Rogers updated his recent logbook entry, adding in the Remarks column "Last Flight." ✈

a 2005 interview. "He just took the ride in the right-hand seat for a few circuits, then I put him in the left seat for a few circuits." Rogers recounted that Hughes was a fast learner, very careful, and applied just the right inputs to the Jetliner's flight controls. He remembered Hughes tended to make his approaches faster than necessary, in order to "feel" the airplane. The entrepreneur had a cavalier disregard for flight plans and radio instructions. "Flight plans weren't mandatory in those days," Rogers said. "He'd just take off on his own private strip and I'd be searching the sky very carefully for other aircraft."

After they landed, Hughes immediately ordered the Jetliner parked on the far side of his airfield, under a tree with guards around it. No one else was allowed near it. "His pilots never did get to fly the airplane," Rogers said. Besides wanting to feel how the airplane performed, Hughes wanted to understand its design and engineering details, so he asked Floyd to sit down with him at a suite in the Bev-

erly Hills Hotel. "We stretched all the drawings out on the dining room table, starting off about seven o'clock at night," Floyd recalled. "I hadn't had my dinner and it went on till about six o'clock the next morning."

In the course of talking with Hughes for 11 hours about nothing but the Jetliner, Floyd came to admire the man's engineering acumen. "My God, he really asked the questions that should be asked," he said. "He was absolutely at home with the drawings and all the things we were talking about. He came across as a very knowledgeable engineer." Floyd later got a photograph of the Jetliner that Hughes had autographed: "To Jim, with commendation for this very good design."

The airplane spent six months at Culver City, most of the time parked. Hughes rented for Rogers and his family a former ambassador's house in Coldwater Canyon with a swimming pool and fruit trees. While Rogers and the crew occasionally enjoyed a little of Hughes'

A Walk *in the* Airpark

WHERE THE AMERICAN
DREAM COMES WITH A
RUNWAY. BY DEL WILBER

MIKE ASHFORD relaxes in the shade of his hangar, watching birds and butterflies dart above a perfectly manicured grass airstrip. It is a clear and cool August afternoon, at least by Maryland standards, and he is in no rush to see it slip away.

He sips a root beer, tells an airplane story or two, and munches on a handful of peanuts. He contemplates getting up to fetch a cigar, then leans back in his lawn chair and looks longingly at a nearby hammock strung between two trees.

Ashford had planned to go flying in his shiny 2006 American Champion Explorer but scrapped the idea when he got stuck in a traffic jam. He doesn't seem to mind how the day turned out. Ashford says that in these lawn-chair moments, workplace stress melts away. He treasures his backyard runway and neighboring soybean field and the sanctuary feel of Kentmorr Airpark, a Chesapeake Bay community that has catered to aviation enthusiasts for six decades.

"This is my oasis," says Ashford, a 71-year-old restaurant owner and former airline pilot. "This is a little micro-universe, only 19 miles from my work. You could measure my blood pressure and see it just drop. This is really a garden of a place."

Though Ashford owns a fun airplane and lives on a grass airstrip, it seems like flying doesn't really matter that much around here. But, like other residents, Ashford says the lure of Kentmorr has more to do with an airplane state of mind than actually flying.



IT CAN BE DIFFICULT to spot Kentmorr's 2,400-foot-long runway from the air as you cross the Chesapeake Bay and circle above Kent Island, a 32-square-mile spit of land that has evolved from a farming community into a pit stop for people racing to the Atlantic beaches and a suburb for Washington- and Baltimore-bound commuters. Kentmorr is bordered by the bay and residential developments, a mix of working-class homes and shorefront mini-mansions with swimming pools and long docks for sailboats.

One of the oldest of the nation's 300-

plus residential airparks, Kentmorr was founded in the late 1940s by Nathan Morris. A poor kid from east Baltimore, Morris picked up the nickname "Bill" after being smitten with Buffalo Bill stories. He dreamed of being a pilot, and built a soapbox airplane with roller-skate landing gear that he raced down steep Baltimore hills. True to his barnstormer inspiration, he sold rides to neighborhood children for a penny. He got his pilot's license in 1938 after taking lessons, for \$4 a half-hour, at a suburban Washington, D.C. airport. Eventually, he would

CAMERON DAVIDSON



Homes line Kentmorr's grass strip, which runs to water's edge. The setting makes this airpark, in one former resident's words, "the prettiest, and I've lived on airparks for 25 years." Opposite: Bobby Thomas props a Luscombe while Kentmorr residents look on.

fly his single-engine Cessna 182, which he named *The Spirit of Maryland*, to Paris in the 1985 Lindbergh Rally. When the Cessna experienced mechanical problems over the Arctic Circle, he landed and was sheltered by Eskimos. A few months after his 90th birthday, he flew 8,000 feet above Cuba on his way to the Cayman Islands. The following year, he flew across the Atlantic for the eighth time. In Spain, where he tried to rent a car, recalls Kentmorr seasonal resident Joel Levin, the rental clerk refused, citing Morris' age. Levin adds: "He was larger than life."

In 1945, looking for a holiday and vacation home with a small airstrip, Morris was flying with his wife, Lillian, in his new single-engine Stinson 108 when he spotted Kent Island. According to a family biography, he was taken with the farm fields and jagged shoreline. He, Lillian, and their two children took a ferry back the next week. Morris bought a 140-acre

farm and plowed a 2,000-foot path through a potato field and planted it with Kentucky bluegrass. He built a house, and soon friends were flying in or taking the ferry to visit, and Lillian would cook for them and visiting strangers alike. Bill built guest houses. Eventually, friends started buying lots along the strip.

Morris dredged a marina and built a restaurant that became known for its crabs, crab cakes, crab pretzels, and crab imperial. On summer weekends, Kentmorr Restaurant still bustles with families and boaters. Over the years, television reporters and print journalists have wanted to do stories on Morris. But he usually demurred.

His daughter, Annette Lerner, recalls that he turned down a proposal by CNN to do a segment on his continuing to fly into his 90s. "If the FAA finds out this old codger is flying at 91, they are going to take my license away," Morris told her. He kept on flying. In 2005, he made his

last solo flight. It was his 98th birthday. He died a few months later.

"He didn't have grand visions, and Kentmorr was what he hoped it would turn out to be," Lerner says. "To my dad, it was always about the airplanes and airplane lovers."

FOR YEARS, AFTER TAKING a ferry or crossing the new four-mile-long Chesapeake Bay Bridge, visitors bound for Kentmorr had to navigate winding and sloppily dirt roads. In recent decades, the roads were paved, and commuters and retirees began to settle in the relatively inexpensive housing. Since 1950, the island has grown from about 2,000 residents to 16,000. Kentmorr saw its biggest expansion in the late 1970s and 1980s, when a group of retiring pilots and their families joined the neighborhood. The residents were close then, friends lured to Kentmorr by other friends. They helped one another build hangars and houses

and airplanes. They stayed into old age.

When Jim Cannon died in 1994, his friends Roger Guest and Bob Martin scattered his ashes over the runway from Martin's Fairchild 24. When Martin grew too weak to hop into the cockpit, Guest flew Martin's Piper Cub around the traffic pattern so Martin could watch it fly. When Martin died in 1999, Guest and another friend scattered Martin's ashes over the runway too.

"We care about the place," says Guest, 74, who moved into Kentmorr in 1987 (and, when he was the airport manager, extended the runway). "It's our home. Bob loved this place. It was just one group, especially that early group, and we lived on like a family compound."

IN RECENT YEARS, housing prices have crept up and a new generation of pilots has moved in—wealthier ones who still work and can afford to have two homes: one near their workplace and the other a weekend getaway on a grass strip.

Mike Ashford, who spends most of his time at a home in Annapolis near his 100-employee restaurant, bought Morris' place in 2006. Vince Massimini, 61, bought his place in 2000 after spotting a for-sale sign while making a proverbial \$100 hamburger run to the Kentmorr restaurant with his wife, Pat. They split time between Kentmorr and a condo near Washington, D.C.

Two years ago, Paul Howey, 56, and his wife, Christiane, 55, bought the old Martin place and are rebuilding its rotted hangar. The owner of a tech company in Columbia, Maryland, Howey spends most of his days at his home in Ellicott City, a suburb of Baltimore.

The demographic changes have created two distinct groups in the neighborhood and they rarely mingle. Longtime residents look askance at their newer neighbors, who aren't around all that much. "It would be nice if they were here year-round," says Peg Cannon, Jim's widow. And the weekend pilots would like to see some new blood in the neighborhood to get more airplanes flying.

"It's a very nice place to live," says Massimini, a former Marine Corps pilot who is a senior engineer specializing in civil aviation for Mitre Corporation and also a docent at the National Air and Space Museum. "But many of the residents are

running past the age where they can fly anymore." Airport manager and former USAir pilot Jack McCarthy is spending most of his time tinkering with a single-engine Pietenpol and building a World-War I-era SPAD fighter from scratch. Mel Barche is recovering from cancer treatment, which has prevented him from taking up his homebuilt Baby Ace, a high-wing, open-cockpit taildragger that he had lusted after since his 20s and finally finished building in 2007. After the death of her husband, Peg Cannon has kept her squeaky-clean hangar filled with cars but no airplanes. And Joel Levin, who splits much of his time between homes in Maine and Florida, doesn't even have an airplane.

Newcomers Ashford and Massimini fly their single-engine airplanes around the Eastern Shore on weekends in search of good food. From time to time, Guest, on his own recreational flight, will run into them at a restaurant, but he admits to having flown a mere 47 hours in the last year.

ON A QUIET AFTERNOON in late June, Anne and Joe Fichera linger over coffee. Their dinner table faces sliding glass doors that overlook the airstrip.



In his shop, where the skeleton of a Marquart Charger hangs patiently from the ceiling, Roger Guest works on a Citabria fairing; in the air, he relaxes in his Cub (top).

For the most part, the active pilots have lives elsewhere. "The new guys like me and Mike Ashford can afford [a second home]. But living there full-time and commuting to our jobs, that is just not workable. Virtually all the newer residents are part-timing. Would I prefer that everyone have an airplane that they fly on the strip? Yes. That would be fun."

In the 1950s, as the head of a general aviation business at Hyde Field in Clinton, Maryland, and working as a mechanic, Joe Fichera got a call from a customer. The fabric covering a wing had torn in flight, and the man had to make an emergency landing on Kent Island. Fichera flew his 1934 Kinner Sportster to Kentmorr, fixed the client's airplane, and fell in love with

the place. A nice field. Good food. A beach. But he couldn't afford the house and lot prices back then. Over the years, he visited the place with his wife and friends.



In the early 1970s, the Ficheras bought a \$6,000 plot next to the runway, and in 1983 Joe installed a Nantacoke factory-built one-story ranch and later added a hangar and a workshop. He retired in 1984 as an aircraft restoration specialist with the National Air and Space Museum, though, like Massimini, he now volunteers there. Fichera restores aircraft that eventually go on display.

"If you own an airplane, it's just the ideal place to live," says Anne Fichera. "You don't have to drive to the airport to get

your plane—you are right here with it. If you want to go flying, you get in your airplane and go flying."

The Ficheras' hangar is filled with airplane photographs, posters, and decals, and that morning, Joe had whiled away some time there, working on his 1930 Brunner Winkle Bird biplane. He bought the Bird in 1946 for \$600. In the early 1930s, Charles Lindbergh owned the airplane and used it to teach his wife, Anne Morrow, to fly. Fichera flew the Bird, restoring it after it was damaged in a wind storm. In 1953, the engine quit on takeoff; Fichera set the airplane down in a plowed field, where it flipped onto its back. The airplane hasn't flown



COURTESY MORRIS FAMILY

Bill Morris (left), who founded Kentmorr, loved: 1) his wife, Lillian, and 2) his Cessna 182. Below: A Stearman dropped in one afternoon and parked with a resident Cessna 172 (at left) and Luscombe (center).



since. But Fichera has been tinkering with it nearly every day for 20 years, repairing the fabric, the wings, the landing gear, and the instruments. Neighbors call the airplane a work of art. Fichera says it has taken so long to fix “because I was too busy fixing other peoples’ planes.”

Still, he won’t be able to fly it himself. Due to glaucoma, Fichera cannot keep his pilot’s license current. He hopes one of his neighbors or friends will take it up and he can fly as a passenger. “It’s frustrating,” he says. “But even if I can’t fly it, I still want to see it fly.”

Anne hears something that could be an airplane. She hustles outside, jumps into a golf cart, and races down the runway as one Cessna 150 after another comes in to land. (All the residents seem to have golf carts. They had a golf cart obstacle contest and race during one of the community’s recent picnics.) The Cessnas are with Keystone Flight, a Pennsylvania-

based club for general aviation pilots. They park their eight aircraft in a row, and the leader, Mike Marra, leads the platoon to Kentmorr Restaurant, where they dine on crabs, crab soup, and crab cakes. They take pictures of everything. One pilot tries to talk a waitress into giving him a live crab as a souvenir.

“This is just such a wonderful spot to visit,” Marra says. “You have the bay and

the grass strip and mostly the food. You can’t beat the food. It’s really a throwback to grassroots aviation. It’s like landing in someone’s back yard for a visit.”

But drop-ins like the one from Keystone Flight are rare. In the old days, residents recall pilots in pursuit of all things crab flying into Kentmorr by the dozen. At times, the line of parked airplanes stretched a quarter-mile down the runway.

Roger Guest strolls the lawns, where airplanes (Cub, foreground; Citabria, background) rather than cars rule. Anne Fichera keeps both, a 1966 Thunderbird and 1958 Aeronca Tri-Champ (right).



The 2001 terrorist attacks changed that. Every day for about a week, a police cruiser parked on the runway to prevent takeoffs or landings, and the government imposed an air-defense zone around the Washington, D.C. region that severely restricted recreational flying and forced others to add costly radio equipment to their cockpits. Pilots wanting to enter the expanded Air Defense Identification Zone also had to file a flight plan. "The ADIZ is a big wet blanket that we'll never recover from," says Roger Guest. "We used to get 20 planes on an afternoon. Now, if we get half a dozen, we get kind of excited."

The feds adjusted the boundaries in 2005 to make Kentmorr more accessible, but traffic didn't pick up much. Only in the last year, since Kentmorr was freed from the restricted airspace, have residents noticed a slight increase in visitors. "It certainly is more quiet than it used to be," says Guest. He misses the air traffic. "That is why we live here, and why it's a public-use airport. We want to see the different planes take off and land."

Guest is sitting on a picnic bench on his back deck, enjoying a lazy summer



CAMERON DAVIDSON

afternoon. In the distance, he hears a familiar buzz, and soon "an ugly looking" airplane circles the field in the wrong direction. It's from a local flight school, and the instructor should know better, Guest says, watching as the aircraft makes its final approach and a "so-so landing." Kentmorr residents are tough critics: They used to judge landings by holding up large cardboard scorecards.

Guest walks over to his hangar and

Former airport manager Guest says it takes three hours to mow the runway, which is done 26 weeks out of 52. The state of Maryland helped Kentmorr acquire the mower, as well as the shed to store it in.

shows off his bright red 1968 Citabria, which took him six years to refurbish. He also now owns Bob Martin's Cub. Hanging from a rack is the steel tube fuselage of a Marquart Charger, a slick biplane that Guest has long wanted to build. In 1998, a friend sold him the fuselage skeleton—"the welding is a work of art," Guest says—on the condition that Guest finish the job. He admits, "It's taking me longer than I thought."

The Charger has hung from the ceiling for 10 years. He has an engine and one wing ready for it. But first he had to fix his son's airplane, and then he gets busy doing laundry and other chores around his bachelor pad or talking airplanes with his neighbors or debating the merits of leveling the runway or installing a pump system to drain standing water after storms.

And soon the day is nearly done. And, like Ashford a few doors down, Guest finds himself sitting in the shade of his hangar, sipping an ice tea and keeping an eye on the backyard airstrip. —



CAMERON DAVIDSON



Left: Jack McCarthy (at right) and Mike Ashford talk airplanes while Ashford's Pietenpol waits to fly. Top, left: Joe Fichera takes a break from working on his Bird. Ashford lifts his American Champion Explorer (top, right) off Kentmorr's grass.

RICARDO TRAVEN, Boeing's chief corporate test pilot for the Super Hornet, was physically in a briefing room at Naval Air Station Cecil Field near Jacksonville, Florida, one sweaty day last June. But mentally, as he prepared to fly a practice routine in the F/A-18E/F, he was eight months ahead and 10,000 miles away at Aero India, a corporate airshow at Air Force Sta-

by Jorge and Karen Escalona

tion Yelahanka, near Bangalore. As he moved the imagi-

nary control stick between his knees, he was flying at 550 mph 200 feet off the ground, competing for one of the biggest fighter contracts in history: 126 aircraft valued at \$10 billion.

The potential customer, the Indian air force, is looking to replace its aging fleet of cold war-era MiG-21s. Though India has traditionally looked east for arms, Traven's job is to fly his F/A-18 so well during the course of the February 11–15 airshow that the business goes to Boeing

The Eurofighter Typhoon, armed for sales combat, will take on Boeing's F/A-18 Super Hornet and Ricardo Traven (below).



JORGE AND KAREN ESCALONA



SUPER

SALES CALL



CRAIG PELLEYMOUNTER

**HOW DO YOU SELL THE WORLD A JET
FIGHTER? IN FULL AFTERBURNER.**



instead. That means each day at the show, he must put the Super Hornet, 30 percent larger than the original F/A-18, through its most aggressive maneuvers with a couple of tons of armament beneath the wings, afterburners going almost nonstop, in order to convince military and other government brass to buy the aircraft.

"I close my eyes when I go through the routine in my mind," Traven says of the preflight ritual. "I'm meditating. I visualize every maneuver in my head, taking into account weather and the wind and what I should expect to see as a result of those variables. No surprises." With precision, he performs eight basic maneuvers, each followed by a repositioning maneuver, all in six minutes, a blur to the spectator but a routine hardwired in Traven's head. He retraces each one in detail before every flight, practice or primetime.

Okay, so not much different from the way most safety-obsessed show pilots would rehearse their moves. But a bad

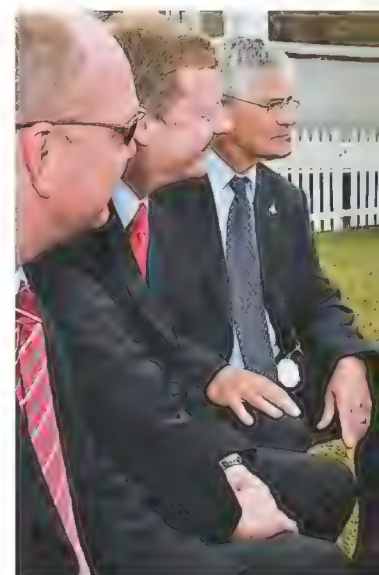
performance by Traven carries bottom-line, balance-sheet consequences for a global aerospace corporation: diminished prestige, lost revenue, perhaps even the early closing of a production line, with the resulting loss of jobs. He's well aware that one wrong flinch of the hand on the control stick could send a supersonic sales pitch toward the ground, killing more than just a sale.

The same goes for the other five contenders heading to Bangalore: Lockheed Martin's F-16 Fighting Falcon; the Eu-

Traven climbs out in the Super Hornet at England's Farnborough Air Show, the flying, buying circus of aerospace.

rofighter Typhoon, made by a European consortium led by EADS; the Dassault Rafale from France; the Saab Gripen from Sweden; and the Russian Aircraft Corporation's MiG-35. The MiG will be the only aircraft to offer thrust-vectoring engines (see "How Things Work: Thrust Vectoring," June/July 2008), which steer exhaust in any direction and let the jet dance in

Troy Pennington (right), Lockheed Martin's F-16 test pilot, inspects the aircraft before each demonstration.



JORGE AND KAREN ESCALONA

mid-air. (The thrust-vectoring Lockheed Martin F-22 is not for sale abroad.)

To try to land this contract, each company will rely on a team of professionals, from the CEO to the engineers who build and prep the aircraft. Plenty of corporate schmoozing will happen behind the scenes. But the most visible element of the process is the test pilot, the man who performs the aerial display and gives the test drive. "A chief of an air force," says Traven, "wants to talk to a pilot."

Traven might put on a business suit for a company event in the evening, but more likely, he contributes during the day, appearing in the booth, briefing room, or chalet in his flightsuit, available for questions from the people qualified to ask them.

"Any country that evaluates a plane has a team doing it," says Traven. "On that team will be test pilots who score the aircraft. They need to like the aircraft to recommend it for purchase. So we meet those folks, and take them flying."

The test drive is a golden opportunity for a salesman to land a sale. For the corporate test pilot, that means guiding the customer through a demo flight. The majority of riders are active military pilots who fly only after preflight simulations with a team of trainers, and cockpit coaching from the test pilot—a minefield of language and cultural differences. A slip of the tongue could destroy rapport with a potential buyer.

Mary Ann Brett, a Boeing public relations representative for the Super Hornet who travels everywhere Traven does, notes that Boeing counts on him for more than flying. "We've brought him into our marketing meetings for his expertise

"I close my eyes when I go through the routine in my mind," says Boeing's F/A-18 chief test pilot, Ricardo Traven. **"I'm meditating. I visualize every maneuver."**

about the aircraft, and for his unique perspective on the customer's requirements," she says. Ricardo picks up on a lot in the cockpit, when he's demo'ing the airplane to the customer, that only he can apply to discussions once on the ground—with either the customer, to explain why the airplane does what it does, or to the Boeing team, to get them to understand what the customer is really interested in or concerned about, likes, etc."

CORPORATE TEST PILOTS prepare a mix of shows: a high show, when good weather permits an imaginary "box" for the pilot to climb to 5,000 feet or more; a medium show, when cloudy weather brings the top of this maneuvering box down to 3,000 feet or lower; and a low show, 1,500 feet above the runway. Any lower and the aircraft simply isn't flown. Pilots work to visualize that box beforehand with their own preflight rituals.

"All the display pilots do this," says MiG test pilot Pavel Vlasov. "You have to cut away the secondary data and concentrate on your immediate mission." Vlasov and fellow test pilot Mikhail Belyaev approach their jets before each display, contorting their bodies to mimic the movements of the routine in a

"walking sortie." To the casual observer, the pilots seem to be dancing a strange tarmac ballet.

"It [the flight plan] has to be crystal clear when you walk to your jet," says Phillipe Duchateau, Dassault's test pilot. "If not, chances are you'll screw up, since there's not much thinking capacity left when pulling 9 Gs." To him, any airplane demands respect. "You can have 5,000 hours on fast jets and still kill yourself in a Cessna trying to impress your grandma."

Airshow officials ground pilots for any deviation from the box. Thanks to strict safety rules, few test pilots have crashed at airshows in recent years. But going back a few decades, there have been tragedies, such as two test pilots who fatally crashed the Northrop F-20 Tigershark during demonstrations in the mid-1980s. Northrop failed to sell a single F-20 (see "The Airplane Nobody Wanted," Aug./Sept. 2000). The Soviets lost two Tu-144 supersonic transports, one at the 1973 Paris Air Show in an accident that killed all six people on

Test pilot Magnus Lewis-Olsson (left) mingles with aerospace executives between hops in the Saab Gripen (below).





"You can have 5,000 hours on fast jets and still kill yourself in a Cessna trying to impress your grandma."

—PHILLIPE DUCHATEAU, DASSAULT RAFALE CORPORATE TEST PILOT

board and eight more on the ground, and destroyed 15 houses. They failed to sell the Tu-144 abroad, and Aeroflot retired it in 1978.

"There's an old saying that's been kicked around," says Troy Pennington, who flew for the Marine Corps for two decades before he became Lockheed Martin's F-16 test pilot. "Are you lucky, or are you good? Risk management is something of a pervasive attitude for us." The day of the show, Pennington repeats the display in his mind countless times, and refers to his deep concentration as "being in the bubble." Two hours early, he heads to the portable maintenance shed near the runway. "When I come out to the airplane, all my maintenance guys are out there and we're jokin'. But there's a point in time where I will walk away to be by myself in the bubble."

The job attracts the sort of pilot able to handle high levels of corporate expectations and public scrutiny. Candidates are chosen from an international military pool and all the top test pilot schools—Pennington, for instance, graduated from the U.S. Naval Test Pilot School in Patuxent River, Maryland, and has more than 6,000 hours in 31 aircraft types.

All the test pilots who will fly at Aero India are superachievers, and the corporations they work for are highly competitive. "It's like watching caged wrestlers in a slap-down fight," says Traven, referring to the intense corporate elbowing already in progress.

In Pavel Vlasov, the Russians may have an advantage beyond their historically good relationship with India's air force. He is considered a master of the MiG, according to his fellow pilots. The corporate test pilot, Vlasov says, "stands out among his colleagues. However, he dis-

plays only the visible part of an iceberg."

Adds Vladimir Barkovsky, deputy general director of the Russian Aircraft Corporation, "In Russia we enjoy a cult of the personality. Historically, Russian pilots are revered personalities because of the attitude towards them within our country.... We love heroes."

Yet it's the capabilities of each aircraft that will ultimately determine who wins the contract. The airplanes differ in weight, from the nimble F-16, which may weigh as little as 13 tons, to the Rafale and Super Hornet, in excess of 20 tons with stores.

"Each pilot showcases what his plane does best," says Gripen test pilot Magnus Lewis-Olsson. "From the Sopwith Camel to the F-22, there is no single aircraft that can do everything. So you show what it is you can do." The highlights of an F-16 performance are effortless vertical climbs; of the F/A-18, barrel rolls with armament; of the MiG, cobra-like high-angle-of-attack maneuvers and controlled stalls.

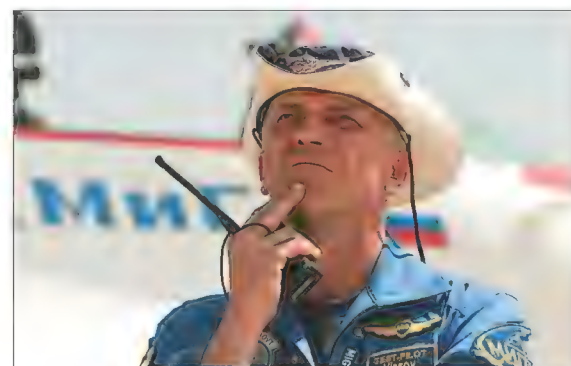
However, with safety a chief concern, pilots often put aside competition in favor of cooperation. They see one another

regularly at all the shows, and in some cases have known one another for years.

"In our opinion there is no competition when you get on that side of the ramp," said Lockheed's Pennington on a July day last year. He pointed toward where the demonstration jets were parked beyond throngs of well-heeled businessmen at the Farnborough International Air Show in Hampshire, England. ("Farnborough," as it is known, is held every other summer to alternate with the Paris Air Show.) "We leave the competition...over here with the guys in suits. The airshow pilot business is camaraderie. It's a club."

Traven, who also flew at Farnborough last summer, agrees that the competing pilots look out for one another. "I've literally climbed down from the cockpit at the end of a demo, run over to the Russian plane waiting to take off, and crawled up the ladder to tell him the tower is calling the clouds at 4,000 feet when they're really at 3,000."

Test pilot Pavel Vlasov flies the MiG-29 (opposite) and the MiG-35, its latest variant. Both offer vectored thrust.



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ARTUR ZAK

The Eurofighter Typhoon (right) wows the crowd at the 2007 Paris Air Show, first held in France's capital in 1909.

"There's an old saying that's been kicked around," says Lockheed Martin F-16 test pilot Troy Pennington.

" 'Are you lucky or are you good?' Risk management is something of a pervasive attitude for us.' "

FOR BIG AIRSHOWS, these pilots train for months, and in Traven's case attend to details as specific as the content of daily meals. Each day's preparation is an exact replica of the previous one, with his display coach, safety officer, and an engineer constantly assessing the routine's risk levels. Traven flies the Super Hornet with plenty of room for error 5,000 feet above the Florida coast near Cecil Field to define the box in which he maneuvers. He repeats the display twice daily, creating a descending "ground line" in the sky until he brings the performance down to 500 feet above the runway.

Why Cecil Field? It's the southernmost facility in the United States where Boeing can support F/A-18 operations. It's hot. It's humid. It's like Bangalore, where, despite being 3,000 feet above sea level, it can be 100 degrees Fahrenheit in February. It makes sense to practice in a similar climate to pinpoint how the engines and flight control surfaces will respond. "I can't find a hot spot in the U.S. 3,000 feet above sea level," Traven says.

In November Traven traveled to India to further prepare for the February show. "I met with the airshow organizer," he says. "I met with the guy that will be the air boss in charge of actual flying displays." It's about familiarization with the base, landmarks, and flying rules. He then assembles a routine he can do in his sleep.

Aero India will differ from the other major international shows. "We're not flying the Indian show for a host of countries," says Traven. "We're flying the show for India. That is a very focused and intentional airshow. There's a lot at stake. There's a lot of pressure."

Nonetheless, Farnborough, which, along with Paris, has become known for major orders of airliners, still offered a good audition for all the fighter pilots honing their acts for India. And those routines took off and landed rapid-fire, as they do at all the big international shows. The most marked difference between a corporate test pilot's demonstration flight at Farnborough, Paris, or Aero India and a military pilot's recruiting flight at a military airshow is



that the corporate pilot is given much less time—rarely more than six minutes, sometimes as much as eight, as will be allotted at Aero India. That's because there's plenty of business to take care of on the ground at a corporate show.

"These international shows, they're more tradeshow than airshow," says Traven. "They're filled with contractors that supply the industry. There are hangars full of them. You almost have to go see it to believe it." With meetings and negotiations starting early in the morning and running through the day, he says, the noise and spectacle of a fighter demo create a distraction. So all the flying happens in a few scheduled hours, say noon to 3 p.m., and the pilots are expected to observe strict time limits.

"It is a very exhilarating six minutes," says Pennington. "It is a helmet fire, and it's very busy, physically demanding, physically straining and stressful, mentally stressful, both in the preparation and actually in the event itself."

"You barely get to breathe," says Traven. "It's really like one continuous maneuver. You're in afterburner almost the

"There's not much thinking capacity left when pulling 9 Gs," says Dassault Rafale corporate test pilot Phillipe Duchateau.



The Eurofighter Typhoon courts buyers at the Dubai Air Show, one of many Asian shows seeing more business.

Still, he says, part of his job is to go “beyond extremes, so that the end-user, when he needs it, can push within a window of safety. We don’t fly up to the ‘edge,’ we go over the cliff. We then come back and we draw a line in the sand for others that says, ‘Cliff here.’”

THE GEE-WHIZ FACTOR of a public display is undeniably important. Says Dave Desmond, another Boeing test pilot, “The international airshow scene caters to two fronts: the public that attends to enjoy the thrill and the noise, but who probably doesn’t fully appreciate the significance of the maneuvering dynamics, and the potential customer, who is keenly assessing the capabilities being displayed.”

“You want to be able to win the hearts and minds of your customer and the public, and there can’t be room for any disappointment,” says Craig Penrice, a former Eurofighter test pilot. “You can’t replace the moment.” He learned that lesson just before a flight at a foreign airshow when a problem arose with the aircraft’s inertial guidance system. “From the marketing standpoint, there was an expectation level [to take off], but I had to cancel the flight,” says Penrice. The company eventually made the sale, but “we learned to always bring two airplanes.”

With multiple airplanes on hand, the six companies and their pilots, ready for business, head to India. There they’ll light the afterburners and trace out their Power Point presentations in the sky, and hope to win a few hearts, a few minds, and all the dollars. ✈

whole time. I burn a thousand pounds [of fuel] a minute.” Because he chooses to carry stores under the wing to portray the airplane in an operational configuration, Traven has to counter drag, and uses the afterburners that much more. By contrast, the ordinary military pilot at a Memorial Day show at some U.S. Air Force base might be in afterburner only about half the total flight time, he says.

To keep things short, corporate show pilots have to perform within that imag-

inary box right over the runway. In the case of Paris, the constraints also keep performers away from airline traffic at nearby Charles de Gaulle International Airport. Military pilots at a military show, on the other hand, get to stretch out in a radius perhaps five miles around the show center, while enjoying 15 or 20 minutes to set up and execute an array of graceful maneuvers. Shows by Britain’s Red Arrows or the U.S. Air Force’s Thunderbirds exceed half an hour.

Not so in Traven’s world. “There’s a relevance for every maneuver I do, and that’s to display the capabilities of the plane to the military operational pilot and senior decision makers.”

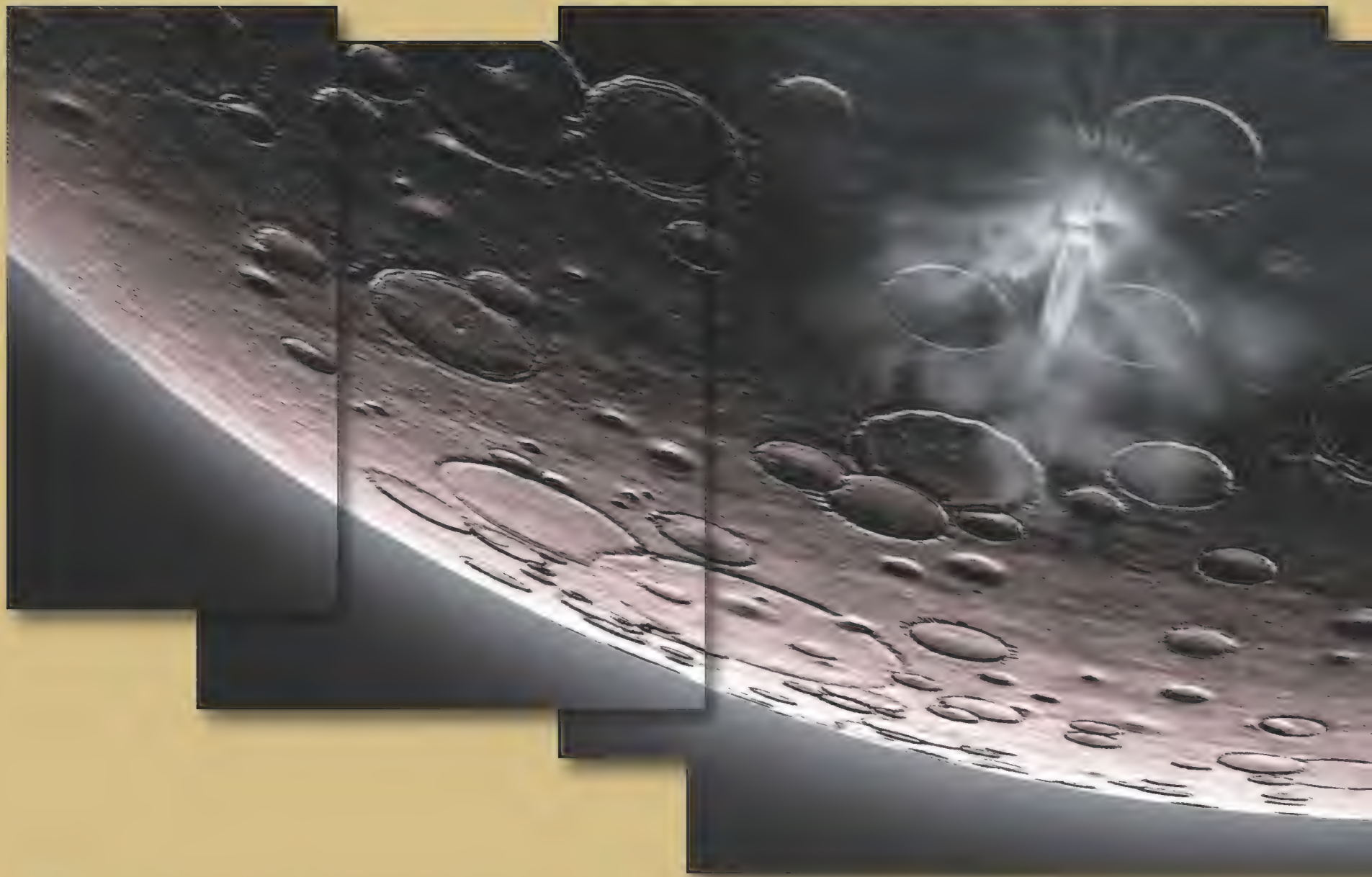
A U.S. Navy pilot briefs an Indian reporter before a VIP flight at Aero India in 2007. Russia’s MiG-35 (right) will be the airplane to beat this year.



KEVIN FLYNN/BOEING



© KAMLESH R. PURSWANI/THE HONG KONG SPOTTERS



THIS SUMMER, BACKYARD ASTRONOMERS may be able to peer through their telescopes and see what happens when a spacecraft smashes into the moon. The impact will be no accident: With an eye to sending humans back to the moon as early as 2020, NASA is on a collision course with Earth's nearest neighbor to learn about potential landing sites for astronauts who may touch down there again—only much more gently.

Like a bullet hitting sand, the Lunar CRater Observation and Sensing Satellite, or LCROSS, is expected to plow into a deep, dark crater on the moon's north pole. The impact should kick up at least 220 tons of lunar material—enough to fill 10 school buses—composed of dust, soil, and possibly water in the form of ice or hydrated minerals. The visible portion of the debris plume is expected to rise about six miles above the surface.

Finding lunar water is critical to U.S. space exploration goals. "If you wish to live off the land, a source of water on the moon could possibly sustain humans over extended durations," explains project manager Daniel Andrews, whose team at NASA's Ames Research Center in California proposed the mission. From drinking water to water turned into oxygen to breathe or use as an oxidizer for fuel, H_2O has the potential to transform the prospect of space colonization into reality. And its worth far exceeds its weight in gold: Shipping a bottle containing two cups of water from Earth to the moon costs as much as \$10,000.

NASA first became intrigued by the possibility of water on the moon after two spacecraft, Clementine in 1994 and Lunar Prospector in 1998, found elevated hydrogen levels while exploring the permanently shadowed craters in the lunar poles. "That hydrogen could be trapped protons from the sun or it

could be some kind of hydrated mineral," says Anthony Colaprete, LCROSS principal investigator and a planetary scientist at Ames. "Or, these dark craters could hold water ice that is literally three to four billion years old, pristine cometary water" brought in by comets that hit the moon during its early formation.

Built in three years for \$79 million by Ames and Northrop Grumman, LCROSS is a secondary payload on an Atlas V rocket that will carry the Lunar Reconnaissance Orbiter, a NASA spacecraft designed to survey the moon's topography and identify possible landing sites for humans. The rocket is scheduled to launch from Florida's Cape Canaveral Air Force Station in late April. Unlike the lunar orbiter, which should arrive at the moon in just a few days, LCROSS will fly by the moon about five days after launch and use lunar gravity to slingshot into an orbit inclined somewhat more than 60 degrees relative to the moon's equator. After a series of orbits around the Earth and the moon both to pick up speed and to align its course for the target crater, the spacecraft will be on its final approach to the moon about 80 days after launch.

LCROSS will be sacrificed for science. About 10 hours before impact, the spacecraft will separate into two parts: the Centaur upper stage, which will keep flying toward the moon, and the Shepherding Spacecraft, which will perform a maneuver to distance itself from the Centaur. Scientists are aiming at one of two craters, one more than a mile deep, the other a little more than half a mile. The 4,400-pound Centaur, about the size of a large SUV, will slam into one of the craters at a sharp angle at 5,616 mph. The impact is expected to gouge out an area half the size of an Olympic swimming pool to a depth of 16 feet. Four min-

ABOVE: PAUL DIMARE; OPPOSITE: NORTHROP GRUMMAN

With \$79 million on the line, NASA hopes a crash landing detected by a companion spacecraft (below) will yield valuable data about lunar ice.

utes later, the Shepherding Spacecraft will fly through the debris plume, taking pictures and measuring the composition of the material, and transmit that data to Earth in real time. Then the 1,500-pound spacecraft will crash on the lunar surface.

"Our pay dirt is going to be the ice, not the dirt," says LCROSS co-investigator Peter Schultz, a geologist at Brown University and an expert on impact craters. Scientists say that, depending on the volume of water-ice excavated, they should be able to determine within one hour of the impacts if the moon really holds vast reserves of water.

Both impacts will be monitored by the Lunar Reconnaissance Orbiter and perhaps by other orbiting spacecraft such as Japan's Kaguya, India's Chandrayaan-1, as well as the Hubble Space Telescope and Earth-based telescopes. "We're specifically tim-

Amateur astronomers were able to observe Deep Impact; they will likely be able to observe the LCROSS collisions as well. "Given clear skies, we expect that you can see the impacts using a relatively modest-sized 10- to 12-inch telescope," says Heldmann. Optimal viewing locations will be from the western United States, and details of the exact impact time and location will be posted on the mission Web site soon after launch. The impacts will be streamed live on NASA TV. Because many amateur astronomers have cameras and spectrometers attached to their telescopes, NASA is also encouraging viewers to upload images of the impacts onto its Web site.

"We're trying to recapture the excitement of the Apollo missions," says John Marmie, deputy project manager. Marmie, who moonlights as



LUNAR SMACK DOWN

ASTRONOMERS GATHER RINGSIDE, AS A SPACECRAFT IS SENT TO SLAM INTO THE MOON. BY MOHI KUMAR

ing the impact to optimize viewing conditions from the large observatories of Hawaii," says LCROSS co-investigator Jennifer Heldmann of Ames. The timing is tricky. "We don't want to impact at new moon, and we don't want to impact at full moon because the moon will be too bright," she says. "We want to have the moon high in the sky and a good distance from dawn or dusk to optimize viewing conditions."

LCROSS is not NASA's first attempt at cosmic collisions. During the Ranger program of the mid-1960s nine probes hit the moon in an effort to capture the first close-up images of the surface. In 2005, the Deep Impact spacecraft crashed into a comet, blasting material from its nucleus. "LCROSS will be quite different from these," says Schultz. "It will be slower than Deep Impact, hitting at a higher angle. And unlike the Ranger probes, there will be direct control over where LCROSS hits and how we observe the plume."

an amateur songwriter, wrote and recorded "Water on the Moon" with a colleague in an effort to put to music NASA's vision for exploration. (The song can be heard on <http://lcross.arc.nasa.gov>.) "We're hoping a new generation of scientists and engineers will take up the challenge to inhabit the moon," he says.

Naturally, amateur astronomers are excited by the chance to see a spacecraft come crashing to an end, and several astronomy clubs through the West are making plans to celebrate the event. "We expect that the impact will fill about one minute of arc, less than the size of Jupiter if you are viewing that planet through the same telescope," says Richard Baldrige of the Peninsula Astronomical Society in Mountain View, California. "This is a rare chance to see something amazing. Even the not-so-die-hards should stay up for this." Baldrige and others will be in Los Gatos, taking turns at two observatory telescopes owned by the society and living it up at an Impact Party. ✈

WHEN AIRLINES SHOP FOR NEW AIRCRAFT, THEY FOLLOW SOME OF THE SAME PRINCIPLES CAR BUYERS DO: GREEN IS IN; GAS HOGS ARE OUT. SO AIRPLANE MANUFACTURERS ARE STUDYING WAYS TO REDUCE EMISSIONS AND MAKE ENGINES LESS GREEDY. THAT'S WHY CECILIO BARBERÁN WAS ABLE TO FLY A POWERED GLIDER LAST YEAR WITH NO AVGAS.

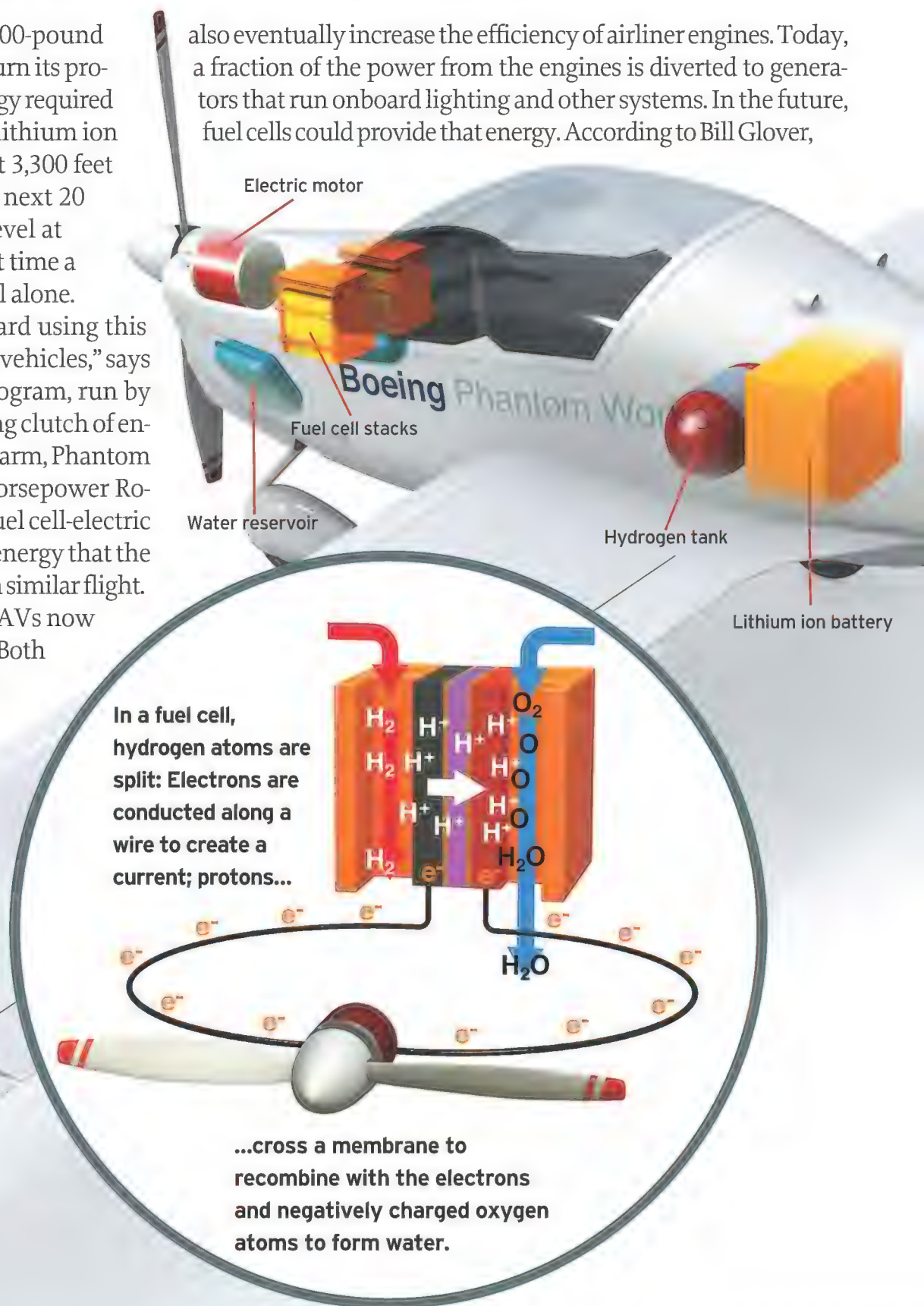
Instead, his HK 36 Super Dimona carried a 200-pound hydrogen fuel cell that ran an electric motor to turn its propeller. The fuel cell couldn't quite put out the energy required for takeoff—45 kilowatts—and got help from a lithium ion battery to lift off the runway in Ocaña, Spain. At 3,300 feet Barberán disconnected the battery, and for the next 20 minutes the Super Dimona flew straight and level at about 60 mph on just the fuel cell. It was the first time a piloted airplane had flown powered by a fuel cell alone.

"Demonstrations like this lead the way toward using this technology in small manned and unmanned air vehicles," says Nieves Lapeña. She heads the demonstrator program, run by Boeing Research & Technology Europe, a far-flung clutch of engineers within the company's advanced projects arm, Phantom Works. Ordinarily the glider flies with an 80-horsepower Rotax engine. According to Lapeña, the hydrogen fuel cell-electric motor combination used only 28 percent of the energy that the internal combustion engine would have used on a similar flight.

Fuel cells could increase the range of small UAVs now operating on battery power, according to Lapeña. Both batteries and fuel cells deliver electrical power from a chemical reaction, but the battery quits when its stored reactants are used up; a fuel cell continues to work as long as its external fuel supply lasts.

Boeing studies fuel cells because they could

also eventually increase the efficiency of airliner engines. Today, a fraction of the power from the engines is diverted to generators that run onboard lighting and other systems. In the future, fuel cells could provide that energy. According to Bill Glover,



Cells

BY MICHAEL KLESIOUS | ILLUSTRATION BY JOHN MACNEILL



Ordinarily an HK 36 Super Dimona would have a four-cylinder Rotax engine under the hood, but for a flight in Ocaña, Spain, last spring (above), an electric motor (below, gray cylinder) drew power from a fuel cell.



BOEING MEDIA (2)

ther if operating temperatures could be increased. Current PEMs are limited to temperatures around 180 degrees Fahrenheit. “A lot of the automobile companies are investigating more advanced membranes that would allow the cells to operate at higher temperatures,” Hoberecht says.

The PEM has drawn the interest of the aerospace industry because it’s portable and can tolerate the expansion and contraction of on-off cycles. It’s also simple—no moving parts—and silent.

Airbus is toying with fuel cell applications too. Last spring, the company ran trials on an A320 airliner proving that a fuel cell could provide power for an electric pump that, through a hydraulic system, moved the airplane’s ailerons, rudder, and other control surfaces while in flight. Before

managing director for environmental strategy at Boeing Commercial Airplanes, relieving the engines of the burden of running generators would save only a small percentage of an airliner’s fuel. But multiply even a tiny fuel savings by the tens of thousands of flights a major airline makes a year: That’s a lot of gas.

For the demonstration flight, the Boeing group used a type of fuel cell called a polymer electrolyte membrane, also known as a proton exchange membrane (PEM). It contains stacks of electrolytes sandwiched between conductive surfaces of opposing charges. Hydrogen protons pass through the membranes, but electrons travel around them. The flow of electrons generates a current to run the engine. The hydrogen protons that have traveled across the membrane recombine with electrons and oxygen from the air to produce water, which can be used aboard an airliner.

PEMs have been around a long time; they were originally developed for NASA’s Gemini program. “The technology has improved tremendously since then,” says Mark Hoberecht, fuel cell manager at NASA’s Glenn Research Center in Ohio. Because of advances in materials used as catalysts in the cells’ chemical reactions, cells produce more electrical power with less waste heat, Hoberecht explains. The efficiency could be improved fur-

fuel cells will be useful on airliners, however, engineers must find a way to increase their power density. “They have to provide more power at lighter and lighter structure,” Glover says.

As for replacing the raw power of a petroleum-fed jet engine, don’t expect fuel cells to do that any time soon, or ever. They will work quietly behind the scenes to keep the lights on, run the air conditioning, and produce water for the bathrooms, reducing water weight at takeoff. As a key figure bringing fuel cells to aviation, Bill Glover warns that there are still unanswered questions about fuel cell dependability: No one yet knows, for example, how fuel cells will perform in turbulence. So while fuel cells won’t debut on the 787, Boeing has designed the airplane to incorporate them later. Glover says that in the next five years the concepts will be tested in the laboratory, “then we’ll migrate them into flight situations when they mature. We want to make sure this works anywhere around the world.”

It already works out of this world. Three 255-pound fuel cells supply electric power to the space shuttle in orbit and produce more than 26 gallons of fresh water a day.



The logo for the band Max Q features the word "Max" in a large, bold, black sans-serif font, and "Q" in a slightly smaller, bold, black sans-serif font. Below the "Q" is the word "LIVE" in a smaller, bold, orange sans-serif font. The entire logo is set against a background of a grid of small, dark squares, some of which are missing, creating a pattern of white space. A large, thick, orange circle is drawn around the "Max Q" text, with the "LIVE" text positioned just below the circle's bottom edge.

Max Q LIVE

THE WORLD'S ONLY ASTRONAUT BAND. BY MICHAEL CASSUTT

IT'S A SCENE AS FAMILIAR to Americans as a Friday night kickoff in September or a Fourth of July parade. The dance hall goes dark...a guitar chord twangs...the stage lights go up...and the band begins to play.

The songs are familiar, since most of them go back 30 or 40 years. "Take It Easy" by the Eagles. The Doobie Brothers' "Listen to the Music." Queen's "Crazy Little Thing Called Love."

The group on stage, in Hawaiian shirts and baggy shorts, looks like a typical middle-aged cover band. But Max Q is anything but typical. Its members are active-duty astronauts.

The cable music channel VH1 used to run a series called *Behind the Music*, which chronicled the history of rock bands from youthful struggle to the inevitable dark

days of booze and faded glory. Max Q had its start in NASA's own dark days—the months following the January 1986 loss of the space shuttle *Challenger* and its crew of seven. "Morale was terrible," recalls Brewster Shaw, at the time a veteran of two missions, now a vice president at Boeing. "We were still mourning."

One day in June 1987 the leaders of the astronaut office decided to do something to raise spirits. They enlisted Shaw and Robert "Hoot" Gibson to help plan a 1950s-style Saturday night sock hop, with ex-Navy pilot Sonny Carter as the DJ and master of ceremonies. Other astronauts were encouraged to come up with skits or karaoke numbers.

Then, as Gibson remembers it, "On Tuesday Brewster sticks his head into my office and says, 'Hooter, what do you think about putting together a four-man band for this sock hop?' " Gibson's fateful response: "Sure, why not?"

After all, he and Shaw were used to playing guitar together at parties. Shaw had also played with George "Pinky" Nelson, another member of the astronaut class of 1978. Nelson recalls, "Brewster

and I used to go over to each other's house, drink beer, play guitars, and scream into mikes, annoying our wives."

That night, the three met to rehearse at Shaw's house and immediately ran into a problem. Gibson says, "Brewster played rhythm guitar, didn't want to play lead. Pinky could play bass or rhythm, didn't want to play lead. I could play rhythm and I didn't want to play lead either.... But my protest was the weakest, so I became lead guitarist.

"I went out to a local pawn shop and bought a Yamaha amp for \$150 and a guitar for \$75. You know it was quality stuff."

Now all they lacked was a drummer. Shaw and Nelson knew that Jim Wetherbee, who'd been in the astronaut corps for three years but hadn't yet flown a shuttle mission, owned a drum kit, which, it turned out, he hadn't played in 17 years. Nevertheless, Wetherbee was invited to the Friday night rehearsal.

Gibson recalls that he came up with the name Max Q, an astronautics term referring to a moment that happens shortly after every launch. "It's the aerodynamic term for maximum dynamic pressure,"

Meet the band (counterclockwise from top): Tracy Caldwell, lead vocals; Kevin Ford, drums; Drew Feustel, guitar; Steve Robinson, guitar; Greg Johnson, keyboards; and (the only non-astronaut in the bunch) NASA flight surgeon Josef Schmid sitting in on bass.



Left: Keyboardist, Elvis fan, and four-time space flier Carl Walz jams on the International Space Station in 2002. Below: Tracy Caldwell joins an all-star band, the World Class Rockers, on stage at a private event in 2007. Former Santana singer Alex Ligertwood is at left, ex-Steppenwolf guitarist Michael Monarch at right.

Shaw says, “and the equivalent of maximum noise.”

On Saturday night, Max Q took the stage in the open air at Walter Hall Park in League City, Texas, not far from the astronauts’ office at the Johnson Space Center. They played a few songs and closed with a medley of Chuck Berry tunes: “I started with ‘Rock and Roll Music,’ says Shaw. “Pinky followed with ‘Johnny B. Goode,’ Hoot did ‘Maybellene,’ and I finished with more ‘Rock and Roll Music.’”

That first appearance—preserved on a video recording that the original band members still guard zealously—could have been Max Q’s combined debut and swan song. Feedback from the rest of the

a keyboard player.” Just like that, the band had its fifth member.

Over the next several months and into 1988, Max Q expanded its repertoire until it could play more than two hours of music. They went on to appear at NASA-related events, as well as a Christmas party and two New Year’s Eve dances at a Holiday Inn not far from the space center. The band even did weddings, Gibson says. “We wound up playing like



COURTESY WORLD CLASSIC ROCKERS

NO ONE’S QUITE SURE what percentage of NASA’s astronauts play musical instruments. Gibson puts it at 50 percent. But only a handful have joined Max Q, or even considered it. Rick Husband, commander of the ill-fated *Columbia*, was famed for his singing voice, but his musical tastes ran to church hymns. Others, like Ellen Ochoa, who in graduate school had been a flute soloist with Stanford University’s symphony orchestra, preferred classical music.

The musical background of the original Max Q members varied greatly. Shaw had joined a rock band called The Gentlemen while attending the University of Wisconsin at Madison. (He also owes his flying career to The Gentlemen. “Our drummer, Steve Schimming, had a private pilot’s license, and one day he took me up in his plane. From that moment on, I wanted to be a pilot.”)

Gibson had resisted a parental order to take up the piano, choosing instead to try the guitar. He even built one himself. “My dad bought me the electronic pickup, but that was all. So I literally got some boards

TWENTY-ONE YEARS LATER, THE BAND IS ON ITS THIRD GENERATION OF ASTRONAUT MUSICIANS, AND THERE ARE NO SIGNS OF DISBANDING. NOT EVEN A RUMOR.

astronaut office was enthusiastic, though. “We weren’t good,” Gibson reflects, “but we weren’t bad. Estella Gillette, one of the administrative staff, asked us if we would appear at a Fajita Fiesta. That was a month away, so we had more time to rehearse.”

Did they worry that their boss, the famously secretive George Abbey, might not approve? “No,” Shaw says. “We were doing this on our own time.” Besides, the Fajita Fiesta’s sponsor *was* George Abbey.

Not long after that, Steve Hawley, who’d been an astronomer before becoming an astronaut, told the musicians, “You need

a real dance band, from 6:30 to 12:30 or 1 a.m.—four sets, fast songs, slow ones.

“We even won a battle of the bands at Clear Lake Park one day. The weather was so abysmal that none of the other bands showed up. So we won by default, and can legitimately claim to be ‘the award-winning Max Q.’”

Twenty-one years later, Gibson and the rest of the original Max Q members are retired from NASA, the band is on its third generation of astronaut musicians, and there are no signs of disbanding. Not even a rumor.



Left: Drummer Chris Ferguson commanded NASA's last space shuttle mission.



The hardest working band in the space business, at the 2004 RE/MAX Ballunar Liftoff Festival (above) and at the STS-114 mission success celebration at Space Center Houston in 2005.



and used HO train wire for the strings.... It sounded awful, but it was a homemade electric guitar."

Nelson, who like Hawley was an astronomer before joining NASA, had played piano and cello as a kid. He also played rhythm guitar in "a pretty good garage band" in high school. "We'd do a show at the local armory or something, charging \$2 a head," he says.

Wetherbee had played drums with the Notre Dame University marching band for a year, but put away his kit when he joined the Navy. "I couldn't take the drums on an aircraft carrier," he says.

As the original Max Q members left NASA or moved on to different jobs, other astronauts stepped up to take their places. First came "Pepe," Navy pilot Pierre Thuot. "I heard that Pinky Nelson was leaving after [mission] STS-26 in fall 1988. So I simply approached the band," he says. Thuot had taught himself to play guitar in high school, and had kept playing during his time at the Naval Academy in Annapolis and in the Navy. But he'd never been in a band.

His audition number was the Eagles' "Take It Easy." "I had to do it twice. The

first time through, I didn't have a monitor. Then Brewster turned up the amp, saying 'You sound better when you can hear yourself.'"

The energetic Thuot quickly took over as the sound man and occasional business manager of Max Q, arranging bookings and practices, setting up the mixer and microphones, and keeping track of set lists. Kevin "Chili" Chilton had studied the clarinet "under duress" as a child, but had picked up guitar while attending the Air Force Academy. When Shaw left the band in 1989 to take a senior job at Florida's Kennedy Space Center, the remaining band members started asking around the astronaut office, "Who owns a guitar?" Chilton spoke up, and that was that—no audition. "I'm not sure they had my amp turned on for the first few gigs," he jokes.

Air Force flight test engineer Carl Walz had been a church accompanist in high school. "I also played keyboards and sang in a rock and roll band in Cleveland—The Fabulous Blue Moons—who had a repertoire very similar to Max Q's, a lot of '50s rock, Sha Na Na, Elvis."

Walz joined Max Q after surviving a

"put up or shut up" moment with a fellow astronaut candidate in a bar in Spokane, Washington, following a survival training trip. "I mentioned [having been in] The Fabulous Blue Moons, but Terry Wilcutt didn't believe me, because I had been one of the quieter members of the group," he recalls. Wilcutt challenged Walz to sing with the bar band. Walz "talked with the band, agreed on a couple of Elvis tunes, then rocked out." The rave reviews got him an invitation to join Max Q.

When Steve Hawley transferred to NASA's Ames Research Center in Mountain View, California, in 1990, Susan Helms, who had just been selected as an astronaut earlier that year, took over keyboards. Helms' extensive musical background—she took piano lessons for 11 years, played concert drums and xylophone in marching bands and choirs, and had played in a jazz combo—came up during her astronaut candidate interview...with Hawley. "I don't know whether he knew he was leaving for Ames at the time," Helms jokes. "Maybe I was being scouted."

She brought a new musical sensibility to the band. "Growing up, I listened to the entire range of music, especially pop, Top 40, everything but country and western," she says. "I learned to be able to sit down at a party and play Elton John and Billy Joel hits." Chilton says Helms "was hugely talented. She could hear a song on the radio, then play it. She was able to teach us harmonies."

The original Max Q lineup had concentrated on music from the '50s and



Left: Max Q co-founder Hoot Gibson (in white shirt) and Kevin Chilton at a 1996 NASA picnic in Florida. **Right:** Dan Burbank and Tracy Caldwell at a 2004 Houston bash.



'60s—surf tunes like “Wipe Out,” The Youngbloods’ “Get Together,” plus instrumentals like Booker T and the MGs’ “Green Onions” and The Ventures’ “Walk, Don’t Run.”

Another favorite was Led Zeppelin’s eight-minute masterpiece, “Stairway to Heaven.” Wetherbee knew how to play the recorder, and his bandmates were convinced that a flute couldn’t be too different. Nelson notes, “There are no drums in the early bars of that song,” so Wetherbee would start on the flute, then sit down to the drums. “I would do the early guitar parts, and Hoot would play the louder parts,” says Shaw. “We actually sounded okay on that song...right up to where the falsetto vocals started.”

When it came to deciding the set list, the band wasn’t always in perfect harmony. “Brewster hated ‘Proud Mary,’ ” Gibson recalls, “so we never played it.” But in general, there were no arguments. According to Steve “Stevie Ray” Robinson, who has been a member since 1996, “Max Q is the most polite, low-key band I’ve ever seen.”

With Max Q’s second generation, Helms and Walz introduced more variety to the lineup. There was still no country and western, and certainly no heavy metal, but, Walz says, “We were playing in the ’90s, so I got the music into the ’80s.” Helms added Van Halen’s “Jump,” Dire Straits’ “Money for Nothing,” and the naval aviator favorite, “Danger Zone,” used in the movie *Top Gun*.

One thing all the members of Max Q, from the original lineup down to today’s, have agreed on: They don’t play space-themed songs like Elton John’s “Rocket Man” or David Bowie’s “Space Oddity.” Why? “Lack of talent,” says Gibson.

WHY WOULD PEOPLE whose schedules are already too full with classroom study, simulations, technical meetings, T-38 flights, and physical conditioning—not to mention families—give up precious free time for a hobby?

One reason was that Max Q’s appearances built morale among the band members’ colleagues. “Our busiest time was after the loss of *Columbia*,” says Canadian astronaut Chris Hadfield, who replaced Pepe Thuot in 1995. “People seemed to want to hear us play. We had more gigs than we normally do—two or three events a month, as opposed to one.”

It has also given astronauts the chance to cultivate their more playful and creative sides. Says Jim Wetherbee, “Pinky Nelson used to say we had too much cerebral cortex and not enough brain stem. I memorized every note of every song, even though as a drummer I really didn’t have to. My dream was to be able to be good enough to get up and play by feel.”

In the mid-1990s, a new generation of players began to join. Hadfield had been playing in a different band in the Houston area when he was recruited. “I wouldn’t call myself the current leader, but I have been with the band the longest—13

years as of 2008,” he says. “So I’ve wound up being the M.C. a lot of the time.”

Gibson left NASA soon after Hadfield joined the band, and Steve Robinson was asked to take his place. Robinson had grown up in the Bay Area in the 1960s and 1970s, when it was a hotbed of acid and psychedelic rock—“when the Grateful Dead still played high schools. The first record I bought was Blind Faith; the second was Donovan,” he says.

His own musical background was eclectic. As a teenager he had played tuba and trombone in the marching band before switching to banjo and bass. He went on to learn guitar and mandolin, and before coming to Houston had played with at least eight bands, in styles ranging from jazz to country. Currently he plays stand-up bass in a folk quartet called Bandella, with Max Q bandmate Hadfield, fellow astronaut Cady Coleman, and Micki Pettit, wife of astronaut Don Pettit.

Along with his musical experience Robinson brought something else vital to Max Q. “I had a truck that helped get us and our equipment to dates. We aren’t held to high musical standards, but we do have to get to gigs on time.”

With no manager arranging tours, and no albums to plug, bookings are somewhat ad hoc. Hadfield says, “Since there are so many of us, we are often approached individually for gigs.” The band members share the duty of arranging the venue, schedule, and payment, “depending on who has time to do it,” according to Robin-



CAMILLA MCGUINN



NASA

son. "We don't get paid; our fees go to equipment, and to pay a sound man," says Hadfield.

The band's biggest moment? According to Thuot, it was "the gig we did for the 25th anniversary of Apollo 11 [in 1994], opening for Cheap Trick at the Houston Hard Rock Café. We did four to five songs, and since Carl Walz was in orbit that night on STS-65, we put his official NASA portrait on our mike stand." A year later, on December 7, 1995, the band made a national TV appearance on ABC's "Good Morning America."

There's been only one attempt to record Max Q professionally. "A Houston disc jockey named Mike Cahill wrote a song for us, 'Another Saturday Night on Orbit,'" says Walz. "We all went to a studio at San Jacinto College, performed it, and left the mix to Cahill." The DJ's final product was wildly different from what the band had recorded. Recalls Walz: "Our biggest decision later was—Do we play *that* version in concerts? Or ours? We went with ours."

Max Q's lineup continued to shift in the 1990s as band members got assignments to the International Space Station. Susan Helms left in 1998 to train for Expedition 2. Ken "Taco" Cockrell replaced her on keyboards. In 2001, Walz had to give up his role as Elvis when he was assigned to Expedition 4. The new Max Q

vocalist was Tracy "T.C." Caldwell, who joined NASA in 1998 and made her first shuttle flight in 2007.

It's never been hard to find recruits.

ONE THING ALL THE MEMBERS OF MAX Q HAVE AGREED ON FROM THE BEGINNING: THEY DON'T PLAY SPACE-THEMED SONGS LIKE ELTON JOHN'S "ROCKET MAN" OR DAVID BOWIE'S "SPACE ODDITY."

Drew Feustel, a member of the 2000 astronaut class, was so eager to join Max Q that even though he'd never played guitar, he bought one and learned. The current members of the band include Hadfield, Caldwell, Cockrell, and Feustel, plus Dan Burbank and Ricky Arnold (guitar), Chris Ferguson and Kevin Ford (drums), Greg "Box" Johnson on keyboards, and Dottie Metcalf-Lindenburger on vocals. Occasionally, NASA flight surgeon Josef Schmid fills in on bass.

The lineup for any particular gig depends on who's in town that night and what instruments they play. "We have never had the entire band on stage at once," says Robinson. "There are actually 576 different combinations of Max Q, which

is why we rarely see the same version of the band twice. Makes practicing difficult, but keeps the sound fresh."

Max Q's members have also done something no other rock band can boast: played music in space. Helms carried a mini-keyboard on STS-54 in 1993, but only to tap out a one-finger version of "Wild Blue Yonder." Ten years later, Walz lived for half a year on the space station and had

a keyboard with him. "I made sure to pick a model that wasn't gravity-dependent," he says. "I played it in my spare time for the first three months on the station, then, for variety, picked up the guitar."

When STS-111 arrived during Walz's stay in May 2002, the commander was Taco Cockrell, Max Q's keyboard player. "So we made sure we found time to play a song—me on guitar, him on keyboards," says Walz. "It was Van Morrison's 'Brown-Eyed Girl,' and we used the Leonardo module as our studio."

Take that, Coldplay. Max Q may never know the thrill of playing to packed stadiums on a 'round-the-world tour. But its members have, in fact, circled the globe. Many times. —

Bring Back the Brute

RE-CREATING THE MOST NOTORIOUS RACER EVER FLOWN. BY ROBERT BERNIER

ON A SPRING DAY IN 2001, I met several other volunteers in the basement of the San Diego Air & Space Museum, surrounded by a stack of construction drawings. Bob Greenaway, a retired Navy machinist mate, was spearheading the museum's building of a Gee Bee R-1, using original plans from the New England Air Museum in Connecticut, which had built its own reproduction in 1990 with help from Pete Miller, the airplane's co-designer.

In the early 1930s, the five Granville brothers, led by Zantford, enjoyed a modest success with the design of a small biplane, but the Great Depression killed off business. To spur innovation, oil companies and aircraft suppliers offered prizes at air races across the country. Zantford gambled the company's future by build-

ing airplanes capable of winning that cash. Working with Pete Miller, a young aeronautical engineer, Zantford created a radical airplane. Sporting tiny wings, a fuselage shaped like a tear drop to minimize drag, and a Pratt & Whitney R-1340 Wasp engine, the R-1 was designed to approach 300 mph at a time when Army Air Corps aircraft could barely reach 200 mph.

Setting up shop in an abandoned Springfield, Massachusetts dance hall, the Granville brothers and about a dozen employees built the R-1 and its sister ship, the R-2, in 90 days. The R-1 was designed to win the 1932 Thompson Trophy pylon race, and

with Jimmy Doolittle at the helm, it did; the R-2, with a smaller engine and increased fuel capacity, was designed for the Bendix Trophy cross-country race.

We had chosen to build a Gee Bee during a museum volunteer meeting. In 2000, Allan Palmer, at the time the museum's executive director, wanted a rare, colorful airplane that would attract visitors. The volunteer craftsmen, mostly World War II veterans old enough to remember the glory days of America's air racers, enthusiastically chose the Gee Bee R-1. No original R-1 or R-2 exists; most of the Granvilles' racers crashed.

Jimmy Doolittle is dwarfed by the monstrous, menacing Gee Bee R-1 Super Sportster (below); at the 1932 National Air Races at Cleveland, Ohio, he set a record of 296 mph (right). He then moved on to less adrenaline-fueled experimental ventures in aviation.





To save time and money, the Granvilles used some off-the-shelf parts for the racers. Ford Model T steering rods were used in the aileron controls, shift knobs from a 1928 Chevy proved handy on the throttle quadrant levers, and a 1931 Indian motorcycle throttle handgrip became the R-1's control stick handgrip.

On a limited budget, we had to be as resourceful as the Granvilles were. Three of us launched the project by hand-planing long lengths of spruce and gluing them together to form the laminated fore and aft spars of the Gee Bee's wing, just as the Granvilles had in 1932.

All aircraft sheet metal work was done by hand in-house; the wheel pants and wing root fillets were shaped by hammers and mallets around wooden molds; the engine cowlings were shaped around concrete molds. Faithful to the original design, the wings consisted of laminated-spruce spars, mahogany plywood ribs, and laminated-spruce wingtip bows, the curved end of the wing. Craftsmen fabricated wing hardware on donated metal-working machinery, some of which dated to World War II. The wings were constructed to airworthy standards, but all the intricate workmanship was lost to view when the wings were covered in a 1/16th-inch mahogany plywood—remarkably thin, yet we still had to soak it in water to render it pliable enough to conform to the wing structure.

Prior to World War II, flying wires—external bracing that supports the wing—were common, but a set for our repro-

The Gee Bee debuted in the San Diego museum in October 2007 (above). At right, top to bottom: Workers brush adhesive on the ribs before fitting the plywood skin; final adjustments and paint touchup; carpenters had their work cut out for them.



ROBERT BERNIER (4)

duction would have cost \$5,000. Dutch Foltz, a 93-year-old craftsman and former Ryan Aircraft tool-and-die maker, worked with other volunteers to fabricate a set of streamlined stainless steel Gee Bee flying wires on the museum's equipment.

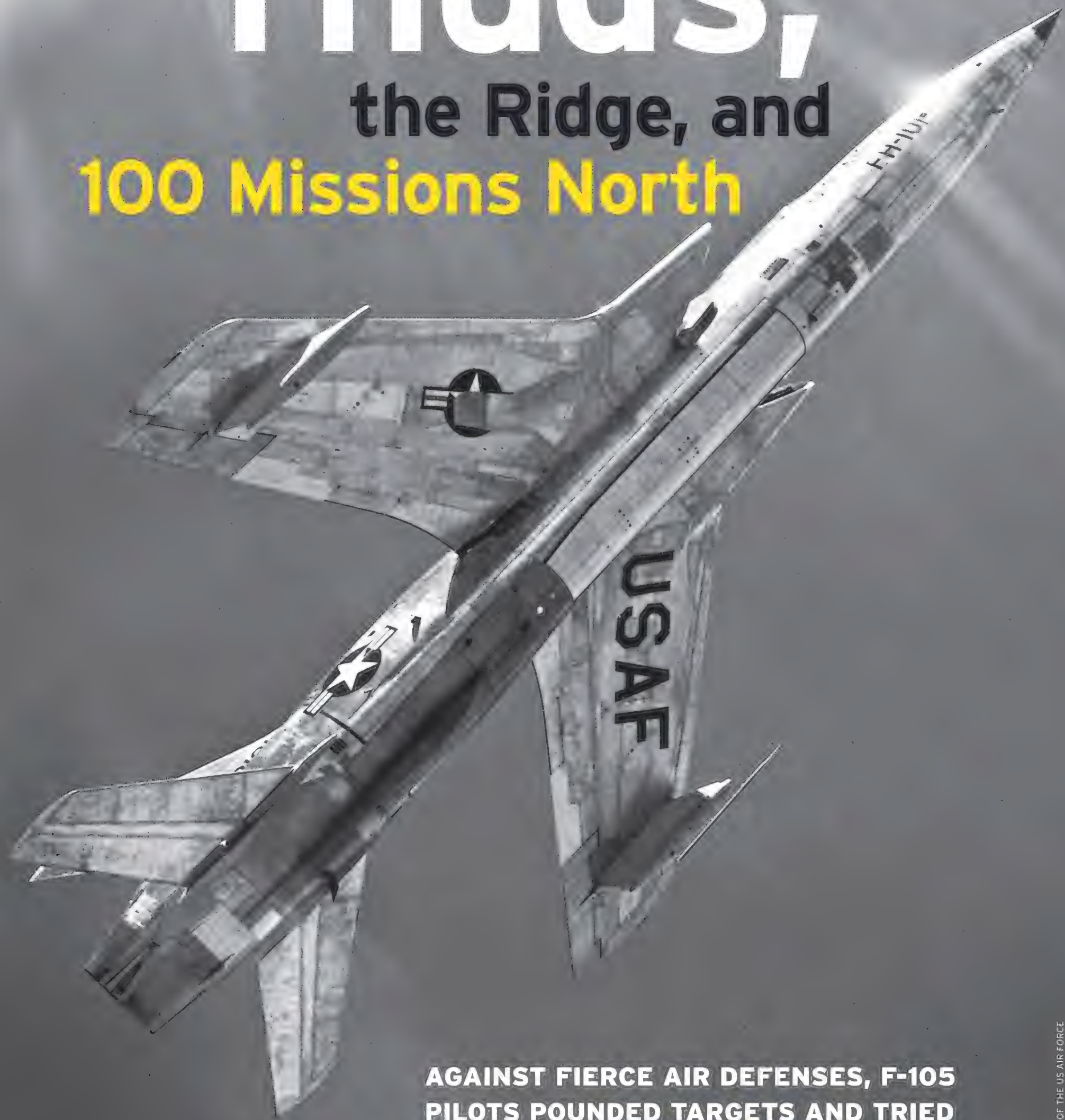
Another challenge was the lack of a large oven to soften plastic for the canopy. Retired Air Force Master Sergeant Vito Altieri came up with a low-tech solution. He placed a plywood mold of the canopy into a modified 55-gallon steel drum and put a flat sheet of plastic atop the mold with weights along two edges. Altieri sealed off the open end of the steel drum and inserted a heat gun into a lid opening. When he turned on the gun, the 400-degree air softened the plastic, and the weights and gravity did the rest.

Visitors touring the Gee Bee construction project wondered why the volunteers

put so much effort into making the reproduction airworthy if the museum had no intention of flying it. The volunteers believe no job is worth doing unless it's done right. Said Allan Palmer, "If you're not building the airplane using original plans, materials, and techniques, you're building a coffee-table ornament."

By the spring of 2007, most of the construction work was completed and the racer was moved to the hangar annex to be painted. The volunteers, most of whom were in their 80s and 90s and were veterans of museum restorations and reproductions, including the *Spirit of St. Louis* twice, milled about the space the airplane once occupied, impatient for another job. We've got a few more years of work on a reproduction of a Boeing P-26 Peashooter, restoring a Vought F4U Corsair, and dealing with wood rot on a Wright *Flyer* reproduction. ✈

Thuds, the Ridge, and 100 Missions North



AGAINST FIERCE AIR DEFENSES, F-105
PILOTS POUNDED TARGETS AND TRIED
TO SURVIVE. **BY CARL POSEY**

LEGENDS OF VIETNAM

AT THE 1854 BATTLE of Balaclava during the Crimean War, British cavalry were ordered to attack withdrawing Czarist artillery brigades. By the time the order cascaded down the chain of command, however, it misdirected the British horsemen into a hail of fire from Russian guns. The debacle caused a furor in England, and inspired Alfred, Lord Tennyson, to pen “Charge of the Light Brigade,” with its mournful refrain: *Into the valley of Death rode the six hundred.*

Just over a century later, something like that infamous charge was performed in modern dress, this time with airplanes, and with the Russian weapons hidden in the forests of North Vietnam. And this time the action was not completed in a single day, but recurred, every morning and afternoon, weather and politics permitting, for more than three years. Charge of the Light Brigade, meet Groundhog Day.

The Republic F-105 Thunderchief, the main aircraft involved in the drama, had never been intended to play the role of a strategic bomber. Rather, it had been created to make a single, low-level nuclear strike—to use its potent stinger once, then die, like a bee.

In January 1952, the U.S. Air Force was seeking such an aircraft, one that could penetrate enemy territory and take out military bases with both conventional and atomic weapons. At Republic Aviation’s Farmingdale, Long Island plant, such an airplane was already taking form as Advanced Project 63 under legendary Russian émigré designer Alexander Kartveli. Republic Aviation was awarded the contract, and the YF-105A first flew on October 22, 1955.

The F-105 seems to have accreted around the single Mk-28 thermonuclear bomb it would carry in a fuselage bomb bay. About the size of a mansion-grade hot-water heater, the weapon could deliver anything from 10 kilotons to more than a megaton of explosive power. The Republic design team took the tubular fuselage of the company’s F-84, a fighter-bomber used extensively in the Korean War, and gave it an area-rule pinch at the waist to improve the transonic behavior of what would become a Mach 2-plus airplane. Wing-root inlets were swept forward to prevent engine stall, and a new Pratt & Whitney J-75 turbojet replaced the proposed J-71. In an era when guns were so 1950s, compared with missiles, someone

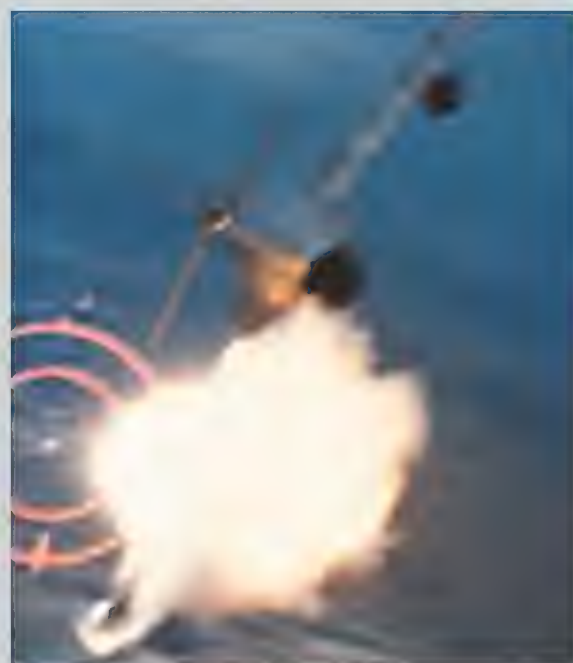
added a 20-mm Gatling in the Thunderchief’s nose.

In 1957, a year before the F-105 entered service, the Air Force had Republic upgrade it with new navigation electronics and radar for all-weather operations, a fire-control system, and a more powerful version of the J-75 engine. The changes yielded the fully evolved, stiletto-shaped F-105D. The aircraft’s 45-degree swept wings measured, tip to tip, not quite 35 feet—about the same as a Piper J-3. But it was no trim little thing. The -105’s vertical stabilizer towered 19 feet above the ground, about the height of the vertical stab of a Boeing B-17G Flying Fortress, and its fuselage was only about 10 feet shorter than the Fort’s, making the F-105D the largest single-engine jet aircraft ever sent to war.

With some fanfare, the D model entered service in September 1960. Wrote a *New York Times* reporter: “The Air Force rates the Thunderchief as the most devastating system of destruction ever controlled by one man.” Accordingly, only high-time fighter pilots were sent to Nellis Air Force Base in Nevada to learn how to wield that power. “You had to have a thousand hours before they let you fly



NATIONAL MUSEUM OF THE US AIR FORCE



NASM (SI 97-15343)

The F-105 (opposite) earned fame as a bridge-buster. Flying out of Takhli, Thailand (left), Thuds also dispatched enemy aircraft, including a MiG-17 (above), felled by the F-105’s Gatling gun.



Thuds Gone Wild

Thunderchiefs came in two-seat models, the F-105F (above) and F-105G, which flew so-called Wild Weasel missions: flights intended to ferret out and destroy surface-to-air-missile sites in North Vietnam. With an electronics warfare officer flying as a backseater, Wild Weasel Thuds located SAM sites by detecting the tracking radar used to guide surface-to-air missiles to their targets. Once a SAM site was exposed, Wild Weasel air crews attacked it with AGM-45 Shrike air-to-ground missiles.

the thing,” recalls Michael Cooper, a Nellis grad. He’d won his wings in 1955, and had been flying North American F-100s. “We transitioned to the -105s in the summer of ’63. I went down to Mobile, Alabama, and picked up a brand-new airplane. Took it home.” Cooper still remembers the serial number, 62-4372. The aircraft flew until 1980, when it crashed during a NATO training exercise in Denmark.

“It was a great airplane,” says Cooper. “Not much of a fighter. But it was so much faster than everything else. The Navy F-4s, we’d fly right through their formations,” closing from behind.

According to Thunderchief pilot Michael Brazelton, the heavy fighter could make “860 knots on the deck, well above the speed of sound. Trouble with going so fast so low is that the canopy starts to melt. We had a double canopy, with

coolant between the layers.”

Raw performance aside, the Thunderchief was “a pretty amazing airplane,” says Ed Rasimus, who went through a later class at Nellis. “We used to do a nuclear profile [training flight]. There was a radar mode you could fly at 500 feet. Gear and flaps up, you’d engage the autopilot, set up terrain avoidance, fly 400 miles, deliver a [mock] nuclear weapon on a target, and take the stick back at 200 feet on final.”

The Nellis grads were sent off to the frontlines separating East and West. Some went to bases at Bitburg and Spangdahlem, West Germany, others were assigned to Yokota Air Base in Japan. From the bases in Germany and at Kadena Air Base in Okinawa and Osan, South Korea, the pilots began standing alerts, nuclear weapons tucked into their airplanes’ bomb bays or hanging from wing pylons, waiting

for the terrible moment to arrive.

The moment never came. Fate had something else in store for the Thunderchiefs and the men who flew them.

ON THE NIGHTS of August 2 and 4, 1964, two U.S. destroyers, *Maddox* and *Turner Joy*, reported an attack by North Vietnamese torpedo boats. Exactly what occurred has been debated for a generation, but, whether real or contrived, this became the Gulf of Tonkin Incident, and a call to war.

“We went down the next day or two,” says Cooper, whose F-105 squadron was based in Japan. The pilots flew into the Royal Thai Air Force Base at Korat, Thailand. “Wasn’t much there when we got there,” he says. “Camp Friendship was the U.S. Army’s. Thais had a little flying school on the other side of the field.” Cooper chuckles, remembering those

early days. “We come in, a fighter squadron and all its munitions. C-130s coming in every 15 minutes dropping something out.”

Those were uncertain times. No one knew if U.S. involvement in Vietnam would trigger Chinese or Soviet intervention. “We were doing all sorts of lines [nuclear missions] on all sorts of maps for all sorts of targets,” says Cooper.

Korat soon became a comfortable little Air Force city. For a time, the -105s—the nukes in the bomb bays replaced with fuel tanks—provided muscle for the CIA’s campaign against Pathet Lao insurgents. Until 1966, the Thai and U.S. governments denied that the aircraft were operating out of Thailand, but it was an open secret. Thunderchiefs were hard to miss.

The aircraft acquired the usual derisive nicknames. Where Republic’s P-47 had been the Jug, the F-105 became the Thud. The origin is unclear. Some said “Thud” echoed the sound of an F-105 crashing in the jungle. Some attributed it to Chief Thunderthud on the “Howdy Doody Show.” As with many such sobriquets, Thud quickly became a term of endearment. The -105 might be a bear to maintain, but the pilots loved its power, speed, and resilience. Thuds came home with large bites taken out of them by missiles and flak. The pilots prided themselves on doing the work of a five-man bomber crew

at or beyond the speed of sound, 100 feet above the jungle, flak and missiles and MiGs everywhere.

Cooper’s squadron was in Thailand about 30 days before rotating back to Japan, where the pilots resumed their nuclear watches. When they returned to Thailand in the spring of 1965, it was to a second field at Takhli.

“Takhli in October ’65 was not much more than when the Japanese left,” recalls Dick Guild (rhymes with “wild”). The base had been built by the Japanese during World War II. “When I first got there we had a mess hall, officers’ club where you could make sandwiches,” says Guild. “We slept in hootches, eight beds to a side. Common washroom, the sinks filled with crickets. No air conditioning. Mosquito netting. Movies in the mess hall.” He grins. “It reminded me of *Terry and the Pirates*.”

He prefers the rough Takhli to the comfortable, Americanized base it became, with swimming pools, a new officers’ club, and individual air-conditioned apartments for the pilots. “Living alone and flying combat is really a bad idea,” he says.

BY FEBRUARY 1965, President Lyndon B. Johnson had approved Operation Rolling Thunder, a bombing campaign by the Air Force and the U.S. Navy intended to crack the North Vietnamese spirit. Because the

Thud pilot Ed Rasimus reported to Korat, Thailand, for a second tour of duty in 1972, this time flying the F-4 (above).

two services did not play well together, planners divided North Vietnam into six route packages, or PAKs, later splitting the sixth into VI-A and VI-B. PAKs I, V, and VI-A belonged to the Air Force, and II, III, IV, and VI-B were the Navy’s. Da Nang-based Marines would share PAK I with the Air Force.

All seven areas were bad, but VI-A was the worst. Bristling with anti-aircraft defenses, it contained the main rail and road routes to China, which intersected at Hanoi. Pilots called Hanoi “downtown,” where, as the 1964 Petula Clark hit put it, “everything’s waiting for you.”

Superposed upon the PAKs were complicated rules of engagement, which put such targets as power plants and airfields out of bounds. Nothing in a 30-mile circle around Hanoi or a 10-mile circle around Haiphong could be hit. The ships pouring supplies onto the Haiphong quays were also off limits. And heaven help the hapless jock who strayed into a 20- to 30-mile buffer zone along the Chinese border.

Pilots could defend themselves from attacking MiG fighters, but could not hit them on the ground. Surface-to-air-missile sites were fair game if they were active; while under construction, they were safe. Targets were selected in Washington, often over a White House lunch, when the president and secretary of de-

After a sortie into enemy territory, an F-105, clean of ordnance, returns to base.



COURTESY ED RASIMUS





NATIONAL MUSEUM OF THE US AIR FORCE

fense, sometimes aided by the chairman of the Joint Chiefs of Staff, mulled over the military's proposed target list, picked some out, and had them relayed back down the line to Saigon and, eventually, to Korat and Takhli. Once something became a target, it remained one. If it wasn't wrecked on the first raid, it would be attacked again and again until it was. Most Sundays the Thuds went downtown.

Rolling Thunder escalated so gradually that the North Vietnamese were able to harden their defenses and hide critical supplies. Their web of anti-aircraft guns and Soviet surface-to-air-missile sites was soon the most sophisticated air defense system in the world.

The word among Thud pilots was that by their 66th mission they would have been shot down twice and picked up once. Put another way, they had about a 60 percent chance of completing the 100 missions north they were required to fly. (Their frequent sorties into Laos didn't count.) For pilots on permanent assignments, 100 flights took about six months to accrue. For those rotating in from Japan, the requirement could take a couple of years.

Whether on permanent or temporary duty, a Thud pilot knew that he was in a knife fight with his good hand tied behind him.

AT FIRST LIGHT, the morning forces at Takhli and Korat would begin assembling for breakfast, briefing, and a good deal of study, with each four-ship flight learning what fragment, or "frag," of the total day's work Saigon had given them. By mid-morning, the pilots were on their way to their aircraft, wearing about 80 pounds of G-suit, parachute, and survival gear. Once the fliers were strapped into their machines, they taxied to an ordnance pit, where ground crews removed the red-flagged pins from the bombs.

"On PAK VI, we'd have eight [750-pound bombs] on the wings," says Guild, or combinations of 500-, 1,000-, 2,000-, and 3,000-pound bombs. "I liked the 3,000. They didn't work for bridges, but for taking out flak pits..." He smiles, his hands describing a big blast wave propagating outward. "I dropped CBU's [cluster bombs]. You could see them down there, *pop pop pop*, but the guns just kept shooting." He wasn't fond of napalm. "God knows where it's going to go."

"The F-105 flew like a heavy T-38," says Brazelton. "Even with bombs on it, I could do an aileron roll. My favorite [configuration] was a centerline tank and a 3,000-pounder under each wing. A lot sleeker."



STEVE WILSON, RETIRED MSGT USAF

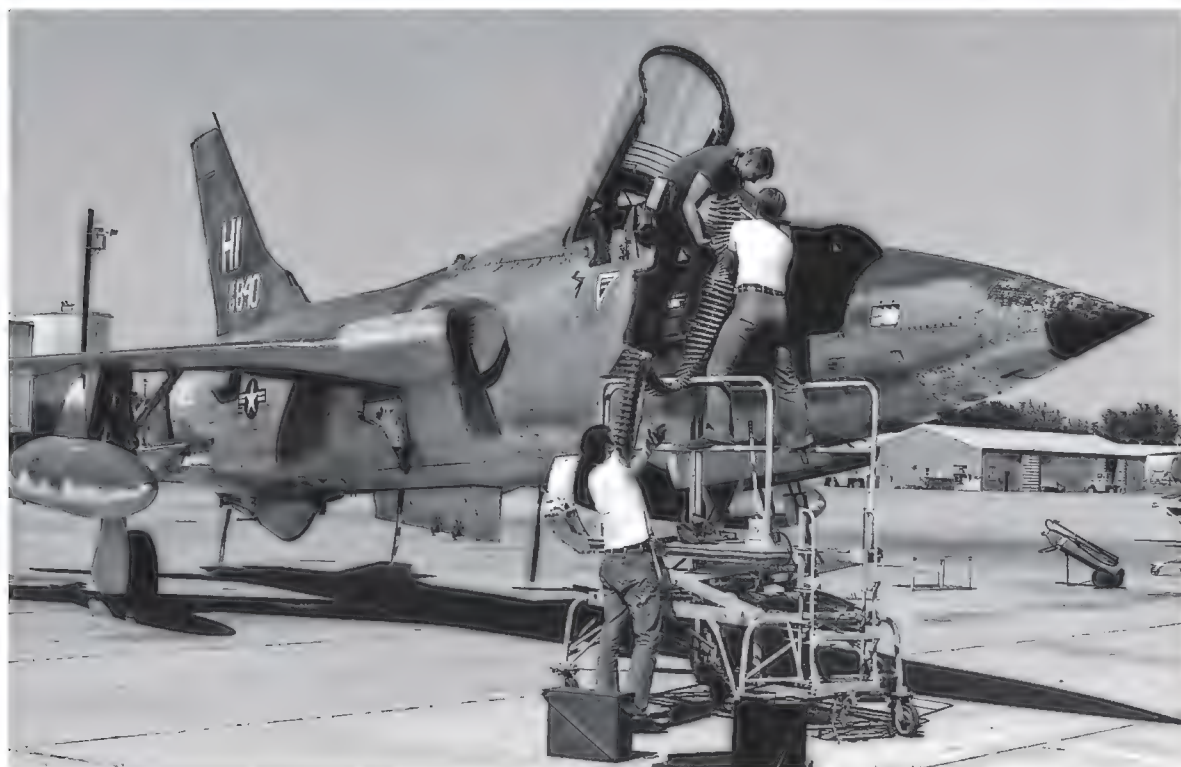
Mike Cooper (second from right) made a stop in Guam in the summer of 1963 while ferrying a new F-105 to Itazuke Air Base in Japan.

The classic PAK VI mission, says Rasimus, was "always a package, 30, 40, 50 airplanes," including a Douglas EB-66 electronic countermeasures aircraft, F-4 Phantoms to fight off MiGs, and Wild Weasels, two-seat F-105F or -G models used to counterpunch anti-aircraft defenses.

Once airborne, the four-Thud formations headed for a herd of Boeing KC-135 tankers flying 30-mile-long racetrack orbits over Thailand. "Each [formation] had their own tanker," says Rasimus. "They'd fill everybody up. Tanker would head north, take us up over Laos, about halfway to the target. We'd quickly cycle through again and drop off with full fuel."

"It took about half our gas to get up there," says Brazelton. "But once refueled, we could fly a long way, a thousand miles."

The F-105s would then head into North Vietnam, flying at 18,000 to 20,000 feet. Going into PAK VI, the pilots followed two main approaches. One took them out over the Gulf of Tonkin, where they then turned to the attack. The other took them along a mile-high branch of the Day Truong Son (Long Chain of Mountains). Paralleled on the south by the Red River, this narrow complex of karsts and dense-canopy forest points southeast toward Hanoi. Americans called it Thud Ridge, after the men who were lost there and the



COURTESY MIKE COOPER

A Douglas EB-66 electronic countermeasures aircraft leads a formation of F-105s on a bombing run (opposite). Before each mission, ground crews fed the Thunderchief's 20-mm Gatling gun with ammunition.



F-105 detritus littering its rough slopes.

"We flew down the center of Thud Ridge," recalls Guild. "If we skimmed it to the south we would get hammered out of Phu Tho and Quan Tri. If we skimmed it to the north, we would get hammered from that valley. I think it was just too hard for them to put AAA guns or SAMs on Thud Ridge." Later in the Rolling Thunder campaign, a heavy-lift Russian heli-

A cigar and some bubbly helped Dick Guild (at left) and fellow Takhli officers John Girardo (center) and Jim Baldwin celebrate Guild's 100th F-105 mission.



COURTESY DICK GUILD

copter added weapons to the ridge.

"We'd go to a target line abreast," says Cooper. "The Thud had a pretty good automatic nav system if you were bombing Vladivostok with nukes, but if you're bombing bridges up in the mountains, you can't even tell which valley or which slope."

"In the cruise in, we'd be on altitude hold, autopilot," says Rasimus. "Not a whole lot of threat. Once down, it was hand flying. You'd want to be jinking a little bit. In the target area at 540 to 600

knots: 4-G pull up, zoom climb, 4-G pull down on the [30- to 40-degree] dive angle, drop it at about 3,000 feet above ground, down to about 1,000 [feet above ground level], then 4 to 5 Gs recovering. After they left the target, it was everybody for himself."

Enthusiasts then had a chance to go trolling for things to strafe with the Gatling gun. It took a while for everyone to see the folly of risking a multimil-

During a flight demonstration Stateside, an F-105 carries a full bomb load: 16 750-pounders. While attacking targets in Vietnam, though, Thuds were generally outfitted with 6,000 pounds of bombs and two auxiliary fuel tanks.

lion-dollar airplane to whack a 10,000-ruble truck, or pitting the 20-mm Gatling against 57-mm artillery, or looking for dogfights. "A lot of people were lost who shouldn't have been, screwing around with a MiG-17," says Cooper. "We could depart from it faster than a missile could track, separating at the speed of light."

That blazing speed made the Thud difficult to protect, says Brazelton. "One time they were thinking of sending F-4s on MiG escort. As we approached the target, we went a little faster, then a little faster. Pretty soon they couldn't keep up with us. We were happier when the escorts stayed away. If there were any MiGs up there, there were plenty of -105 pilots eager to pull the trigger."

Even with the disadvantages of the F-105's weight and poor turning ability, when the smoke cleared, it was Thuds 27.5, MiGs 22, with 24.5 Thud victories credited to that fossil nose-mounted gun.

Going in or coming out, if someone got hit—and someone almost always did—the Thuds usually kept moving. "In 1966, when

a guy got shot down, if he wasn't picked up in the first 90 minutes, he wasn't coming out," says Rasimus.

"In PAK VI, if someone went down across the Red River, we'd continue on, but the wingman would stay with a crippled bird," says Guild. "If someone went down on the way out, we would continue egress, try to get to him later. You don't want to pinpoint the downed guy."

Brazelton had almost finished his 100-mission tour when he got smoked. It was August 7, 1966, north of Hanoi. "I was dropping CBU's on a 120-mm anti-aircraft site," he says. "A 57-mm must have hit me right in the belly. I rode it for a minute or so, told them I was ejecting. They couldn't do anything, just too many guns. I didn't ask them to." (Brazelton spent the next six and a half years as a POW.)

Coming off the target, the F-105s stayed together and headed for the tankers. They took enough fuel to get back to base, where, some four hours after their takeoff, the afternoon shift was preparing the next charge against the Russian guns.

THE 388TH TACTICAL Fighter Wing settled into Korat, the 355th into Takhli. As pilots and aircraft were lost at the rate of five or six a week, replacement air crews and aircraft flew in, the Yokota units to Takhli, Kadena units to Korat. Thud pilots from Europe also arrived.

There were rivalries. In his memoir, *Thud Ridge*, Colonel Jack Broughton, then vice wing commander at Takhli, refers to Korat as the "Avis wing." Over at Korat, the word was that Takhli had some people interested in becoming heroes. Some accounts make both wings sound like Texas Aggies about to play the Longhorns. There are tales of the "pressure bar" at Takhli, where pilots recited stuffy Pentagon nonsense about their incompatibility with "normal management techniques," yelled a few obscenities, sang some unprintable songs, and shattered their bottles on the floor.

The late Gene I. "G.I." Basel, in his 1982 memoir, *Pak Six*, describes impromptu wakes at Takhli for lost comrades. Pilots

from the day's raid would run a gauntlet of hurled beer bottles, trying to reach the far wall, called Thud Ridge, unscathed.

Both bases adopted Australian bush hats and kept their missions tallied on the rims. Pilots tend to be superstitious. That bush hat couldn't be left on the bed or on the dresser. Crickets in the wash room were not to be smushed. At Korat, a mustache rendered the pilot bulletproof; shaving it off was tantamount to suicide.

"We drank more than we needed to, but I always tried to get six or eight hours sleep before a mission," says Cooper. "A hundred missions in six months: That's 16 or so sorties a month. Every 16 days you'd get four days off. I tried to make Bangkok the center of my universe."

Guild's main memory of Takhli is "being tired all the time."

Behind the wild-bunch reputation, the Thud crews were a pretty serious lot. "I tried not to think big thoughts in those days," says Cooper, "but I really wondered whether I'd see my kids again." He also worried about the prisoners of war. "A bunch of good buds up in that hell. I thought about that a lot." According to former POW Mike McGrath, now historian of a POW organization, of 207 fighters and fighter-bombers downed over North Vietnam, 99 were Thuds.

The Thud experience was not for everyone. "We had people, when it came to the point where they had to fly, they'd quit," says Rasimus. "One kid got shot down on his first mission, got picked up, came in when he got back, and handed in his wings."

There was good reason to fear the daily gallop into North Vietnam. "The losses were appalling," wrote Rasimus in his 2003 memoir, *When Thunder Rolled*. "The class of nine that had been six weeks ahead of mine at Nellis lost four. The first short-course class of 'universally assignable' pilots lost 15 out of 16, all either killed or captured.... For every five pilots that start-



COURTESY MICHAEL BRAZELTON

"The F-105 flew like a heavy T-38," says Michael Brazelton. "Even with bombs on it, I could do an aileron roll."

ed the tour, three would not complete it."

Wrote Basel in his book: "I walk the streets and still grieve for them, and for those that did return, for all the others and for myself.... What was it all about? This magnificently orchestrated event that accomplished nothing. Casualties of this monstrous charade, we ask, For What?"

For others, the combat habit acquired in Thuds proved impossible to kick. No one was required to return to the unfriendly skies of Southeast Asia, but many did. Karl Richter flew his 100 missions out of Korat, then signed up for 100 more. Near the end of the second tour, he was killed on a run into PAK I. Several years after their first 100 missions, Rasimus, Cooper, and Guild also came back for another 100, this time in F-4 Phantoms.

Some returnees might have hoped to finish the thwarted work of Rolling Thunder. But most seem to have been drawn back to the metaphorical Balaclava by memories of the adrenaline rush, the camaraderie, the exhausting, exhilarating life spent on the edge, doing work only the brave can do.

At the same time, the Thud pilots understood that they risked everything to achieve results that were often questionable. It reminded Rasimus, who grew up in Chicago, of stealing hubcaps. ✈

Sightings

PICTURES WORTH A SECOND LOOK

AN AD CAMPAIGN WITH ENERGY, the Red Bull Air Race, dreamed up by marketers of the Austrian energy drink of the same name, is an eye-popping mix of aerobatic flying and auto racing (see “Red Bull’s Rodeo,” Apr./May 2005). Using the most agile, lightweight airplanes available, pilots navigate a “track” of 65-foot-high air-filled pylons at speeds reaching 230 mph, and at times pull 12 Gs. First held in Zeltweg, Austria, in 2003 before several hundred thousand spectators, the race soon went global. Last year, 12 world-class pilots touched down at eight locales in six countries, tallying points toward a year-end winner. The 2008 champ was rookie Hannes Arch of Austria. Clockwise from right: Paul Bonhomme goes vertical in an Edge 540 in London; Nigel Lamb in an MX2 and Kirby Chambliss and Alejandro MacLean in Edge 540s form up over Abu Dhabi; Alejandro MacLean goes over the top in an Edge 540 above Monument Valley, United States; and Mike Mangold stands on his tail in an Edge 540 at Rotterdam’s Erasmus Bridge (no, sorry, he didn’t go under it).



JOERG MITTER (2)



JOERG MITTER



CHRISTIAN PONDELLA

Then & Now

FROZEN MOMENTS AS TIME MARCHES ON

A Weighty Matter

AIRLINES HAVE ALWAYS been sensitive to takeoff weight because every pound burns fuel. In aviation's early days, flying commercial meant counting not just pounds but ounces. Not only were bags weighed; people were too. For its inaugural San Francisco-to-New York flight in 1933, Boeing Air Transport made sure its Boeing 247D with 10 passengers and one flight attendant was no heavier than 16,805 pounds at takeoff.

"The 247 was not exactly a 747," explains Michael Lombardi, Boeing's historian. "The weight of the stewardess and her equipment—lunches, thermos jugs of coffee, blankets, pillows, magazines, fly swatter—was figured in as a constant part of the airplane," he says. The airline allowed 121.5 pounds for all the convenience items and 135 pounds for the flight attendant, who was weighed planeside along with the sacks and crates.

Passengers using England's Croydon Aerodrome in the mid-1930s had to step on scales with their bags in hand, recalls Frank Anderson, chairman of the Croydon Airport Society. "The snag was that if you were very large, you would pay more not only for your baggage but for yourself," he says. "Some of the booking clerks were discreet when announcing the weight, especially with the ladies."

By the early 1950s, U.S. airlines largely had stopped weighing people, relying instead on standard government tables to calculate the proper weight and balance of the aircraft. The Federal Aviation Administration updated those tables in 2005 with Advisory Circular 120-27E, which calculates an aircraft's



Briefcase in hand, a passenger weighs in at London's Croydon Aerodrome (left) before a flight to Scotland in 1934. The checks were necessary to ensure the airplane wasn't too heavy for takeoff. Today, most airlines use weight estimates for passengers, and put only checked bags on scales (below).

operational empty weight, cargo payload, and the weight of fuel and passengers to load for proper center of gravity. For passengers, the FAA now figures an average man in summer clothes weighs 200 pounds and the average woman, 179 pounds. On flights between November 1 and April 30, when winter clothing is factored in, the FAA adds five pounds. The standards will be revised if data from U.S. government health agencies show that the average American has gotten at least two percent heavier.

Carriers now separate the fees for baggage from the basic fare they charge customers. Robert Mann, a former airline executive who is now an airline consultant, thinks the pricing is partly meant to encourage passengers to reduce the volume of luggage in the cargo hold and overhead bins.

Although airlines have said they don't plan to start

putting passengers on scales again, they continue to keep a close eye on baggage weight. Last summer, amid soaring fuel prices, American Airlines was among the first to charge for the first checked bag. And in November, airlines began slimming the size of carry-ons with new rules, fees, and the installation of sizing frames at security machines to block oversized items. Since weight increases costs, passengers and airlines are partners in the bottom line.

ROGER A. MOLA



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Forces of Nature

A former astronaut and a planetary geologist reveal how volcanoes, wind, floods, and asteroid impacts have shaped the solar system.

Planetology: Unlocking the Secrets of the Solar System

by Tom Jones and Ellen Stofan.
National Geographic, 2008. 217 pp., \$35.

I CAN'T THINK of a better pair to write a book on our solar system's planetology than Tom Jones and Ellen Stofan. Both Jones and Stofan, friends since meeting in graduate school, are scientists as well as modern-day explorers. Jones is a former NASA astronaut who flew on two space shuttle missions, while Stofan worked at NASA's Jet Propulsion Laboratory in Pasadena, California, as a planetary scientist.

Together they provide a comprehensive view of scientific research: While Jones was working on the space shuttle's Space Radar Laboratory, for example,

Stofan was one of the scientists at mission control analyzing the SRL's data. The joint effort resulted in one of the book's most important images: the Virunga volcanoes, located on the border of Congo and Uganda. The image was



NASA/GSFC/METI/ERSDAC/JAROS AND U.S./JAPAN ASTER SCIENCE TEAM



Studying the erosion that formed the braided islands of the Betsiboka River Delta in Madagascar helps scientists understand erosion on other planets.

requested by the Dian Fossey Gorilla Fund so that the organization could better map the habitat of the area's endangered mountain gorillas.

In addition to NASA images, the authors use personal photographs to

illustrate the science. One example, which demonstrates the fury of Earth's own geology, shows Stofan and her daughter standing next to a large rock expelled from Italy's Mount Etna when it erupted days before the photo was taken.

Images like these make the book an engaging look at scientists at work.

A GEOLOGIST AT THE NATIONAL AIR AND SPACE MUSEUM'S CENTER FOR EARTH AND PLANETARY STUDIES, BOB CRADDOCK RESEARCHES THE EROSION OF VOLCANOES ON MARS. FIELDWORK HE CONDUCTS IN CENTRAL AUSTRALIA HELPS EXPLAIN THE FORMATION OF DUNES ON SATURN'S MOON, TITAN.

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Finding a Fallen Hero: The Death of a Ball Turret Gunner

by Bob Korkuc. University of Oklahoma Press, 2008. 256 pp., \$24.95.

TAKE A MOMENT to study the full-page black-and-white photograph at the beginning of this book. It's of

Anthony Joseph Korkuc, a kid of about 27, nice-looking, friendly, maybe a little cocky—could be a guy you met in college. Except he's wearing a U.S. Army Air Forces dress uniform from World War II.

Anthony is the uncle of Bob Korkuc, and that's about all Bob, the

author, knows when he and his father cap a tour of Civil War battlefields in the late 1990s with a trip to Virginia's Arlington National Cemetery to visit the memorial of dad's brother Tony, a ball turret gunner who was shot down in a B-17 over Germany. When they get to Arlington, though, things don't add up: There is no memorial. Though Tony's body was supposedly never recovered, there is a grave with his name. And he is buried with three other men.

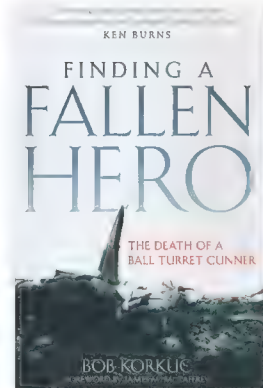
Why?

Curiosity piqued, Bob Korkuc, an electrical engineer in his late 30s, makes finding out about his uncle's last mission his mission. He turns to the Internet. Of the B-17's 10 crew members, only four survived the shootdown. He tracks them down to get their perspectives on "Korky" Korkuc's last moments. The pilot's story is the most heartbreaking: More than 50 years later, he can't forgive himself for losing more than half his crew.

As he puts together the puzzle of his uncle's death, Korkuc learns what it was like to be a B-17's ball turret gunner: to spend hours curled up around two machine guns in a space so tight the gunner can't even wear a parachute. The gunner is also cross-trained as an engineer, because exploding German flak slices engines, fuel lines, controls, and radios.

Korkuc's not a professional writer, and it shows. But his earnest, methodical, heartfelt account makes the story of what happened to his uncle that much more appealing.

PHIL SCOTT IS THE AUTHOR OF *HEMINGWAY'S HURRICANE: THE GREAT FLORIDA KEYS STORM OF 1935* (McGraw-Hill, 2005). HE WROTE ABOUT THE RESTORATION OF THE USS *INTREPID* AIRCRAFT CARRIER (AUG./SEPT. 2008).



>>> Aviation: At a Glance <<<



Allied Fighters, 1939-45

by Chris Chant. Zenith Press, 2008. 192 pp., \$19.95.

Organized by country and chronology, this aircraft identification guide includes descriptions of unit formations, aircraft insignia, and squadron markings.

Hard Air: Adventures From the Edge of Flying

by W. Scott Olsen. University of Nebraska Press, 2008. 246 pp., \$19.95.

Olsen examines the working lives of pilots flying under extreme conditions: hurricane hunters, helicopter pilots transporting critically injured patients, Canadian bush pilots delivering supplies to the Arctic, and firefighting tanker pilots.



American Attack Aircraft Since 1926

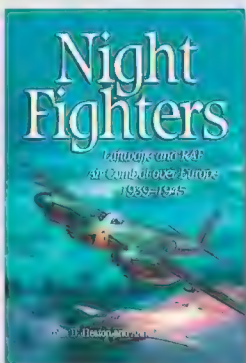
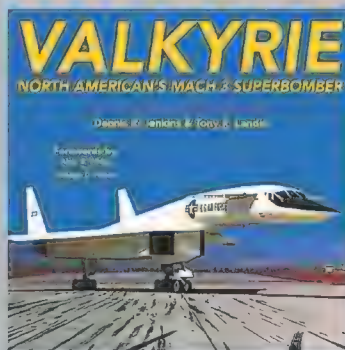
by E.R. Johnson. McFarland, 2008. 449 pp., \$95.

A concise historical survey covering four types of fixed-wing attack aircraft: designated attack aircraft; light, medium, and tactical bombers; fighter-bombers; and adapted attack aircraft.

Valkyrie: North American's Mach 3 Superbomber

by Dennis R. Jenkins and Tony R. Landis. Specialty Press, 2008. 264 pp., \$26.95.

Military, NASA, and company archives provide the base for a thorough history of the XB-70 program.



Night Fighters: Luftwaffe and RAF Air Combat Over Europe 1930 - 1945

by Colin D. Heaton and Anne-Marie Lewis. Naval Institute Press, 2008. 188 pp., \$27.95.

This book tells the story of the aerial duel between Britain's bomber command and Germany's night fighters during World War II.

Reviews & Previews

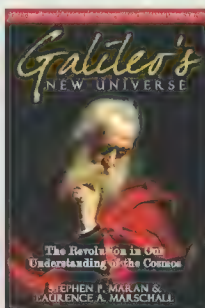
Rampant Raider: An A-4 Skyhawk Pilot in Vietnam

by Stephen R. Gray. Naval Institute Press, 2007. 288 pp., \$32.50.

DURING THE VIETNAM WAR, Stephen R. Gray went straight from naval flight training to combat. The most junior pilot in Attack Squadron 212, the “Rampant Raiders,” Gray was relatively inexperienced when he confronted North Vietnam’s daunting air defenses in his A-4 Skyhawk, an attack aircraft so small it didn’t need folding

wings for shipboard stowage.

All told, Gray logged 250 combat sorties and 300 carrier landings, giving him the material to write a superb account of what it’s like to fly and fight. “It was a hazy, gray day with a high, thin cirrus overcast about ten thousand feet above us that would silhouette our airplanes against the sky, making optical tracking easier for the North



Galileo's New Universe: The Revolution in Our Understanding of the Cosmos

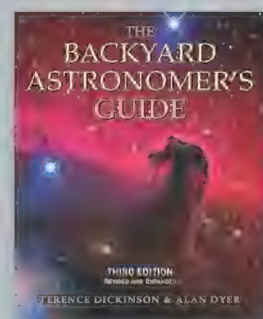
by Stephen P. Maran and Laurence A. Marschall. Benbella, 2008. 172 pp., \$14.95.

Maran and Marschall, both *Air & Space* contributing editors, track the evolution of astronomy from Galileo’s time to the present.

The Backyard Astronomer's Guide

by Terence Dickinson and Alan Dyer. Firefly, 2008. 368 pp., \$49.95.

The third edition of this reference work for amateur astronomers features hundreds of new illustrations and step-by-step guides to taking celestial images with digital cameras.



Vietnamese gunners,” Gray writes as a bombing mission begins.

Gray’s prose compares with the best work ever written by pilots about wartime experiences. His descriptions of the air action, however, would be accessible to more readers if passages had been scrubbed of military abbreviations like XO, LSO, and NATOPS (executive officer, landing signal officer, and Naval Air Training

and Operating Procedures Standardization, respectively). Still, Gray offers readers a thrilling journey into the life of a carrier pilot.

ROBERT F. DORR IS A U.S. AIR FORCE VETERAN. HE WRITES A WEEKLY COLUMN FOR *AIR FORCE TIMES* NEWSPAPER. HE IS THE CO-AUTHOR OF *HELL HAWKS*, A HISTORY OF A U.S. FIGHTER GROUP IN EUROPE IN THE FINAL YEAR OF WORLD WAR II.

>>> Excerpt <<<

X-Plane Crashes: Exploring Experimental, Rocket Plane, and Spycraft Incidents, Accidents and Crash Sites

by Peter W. Merlin and Tony Moore. Specialty Press, 2008. 160 pp., \$29.95.

TONY WAS THINKING about searching for the XB-70, too. In 1989 he stopped in Lancaster [California] to check out an aviation collectibles store called Thomas Aviation. There he saw a photo of the store’s owner, Tom Rosquin, standing in the desert holding pieces of the XB-70. Tony questioned the sales clerk, an elderly lady nicknamed “Smitty,” about the crash-site location.



Smitty told him to “look near the radar dish.” Tony thought that meant the Deep Space Tracking Station at Goldstone and ended up making a fruitless search in the vicinity of Superior Valley.

After expending a great deal of time and effort, making several journeys to the Barstow area, and questioning Rosquin and various Barstow locals, Tony wasn’t about to give up. Rosquin ultimately provided Tony with enough clues to get him into the right area. Tony had been studying old photos of the crash site until the images were burned into his brain. As soon as he got close to the site, he

THE X-HUNTERS RETURN

Profiled in the Feb./Mar. 1995 issue of *Air & Space/Smithsonian*, aviation archeologists Pete Merlin and Tony Moore have published a book detailing their searches for the desert crash sites of the most storied U.S. experimental aircraft. The following excerpt, from a chapter titled “The Blackest Day in the History of Edwards,” describes Moore’s hunt for the remains of the North American XB-70 Valkyrie, which crashed after colliding midair with a NASA F-104 Starfighter on June 8, 1966.

experienced an intense sense of déjà vu. He recognized a distinctive large Joshua tree and knew he had arrived. Stepping out of the car, Tony spotted a metal fragment with white paint on one side and stainless steel honeycomb on the other. He had found it!

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FLYBY

ARTICLE WRITTEN BY: BRIAN GROTE

Dear Brian,

I've been flying for over 20 years. My usual run is a Denver departure at 9pm, fly to Billings, on to Cheyenne and then back to Denver by 5am. I fly a King Air 350. I love my career and I pride myself on doing the best job I possibly can.

Last time out, however, I was making lots of little mistakes. I was cleared for the ILS Runway 35R into Denver, but I couldn't pick up ATIS. That's when I looked at my radios and noticed I had dialed in the wrong frequency. I glanced again and dialed in the right frequency. I continued through my checklist and set my Radar Altimeter to 5500 feet. I was ready to make my descent and start my approach. After the outer marker I glanced at my DH again and noticed that I had set my Radar Altimeter, 67 feet low. Luckily, I landed safely, bouncing the wheels just a little.

After a couple more days in the sky I could tell my eyesight was beginning to deteriorate. I knew I wouldn't be able to renew my first class medical if I didn't do anything about it. I was really worried and started asking my peers if there was anything I could do. A co-worker gave me a bottle of Claroxan™ and told me it would help me maintain my depth perception. I was skeptical at first, but tried it anyway. As it turns out, the stuff works great. The problem is, I ran out and don't know where to find more. Have you heard of this Claroxan™ stuff? Is it available in the States?

Jason, 46 – Seattle, WA

Jason,

Not only do I know of Claroxan™, it just so happens I take it everyday. Being a pilot myself, I know that perfect visual acuity is an asset none of us can afford to lose. That's why every pilot should be protecting their eyesight before it's too late.

Claroxan™ contains ingredients proven beneficial for the eyes. Among these ingredients are lutein and zeaxanthin – powerful antioxidants that have been clinically proven to protect the retina and macula and, in some cases, reverse the damaging effects of macular degeneration. These antioxidants block damaging UV rays and halt damaging free radical oxidation in the back of the eyes. They have also been clinically proven to decrease the risk of cataracts.

Claroxan™ also contains bilberry, an antioxidant known to improve night vision. Bilberry's night vision enhancing effects were first noticed in England in the early 1940's. The RAF ordered English fighter pilots to eat bilberry jam on toast figuring it would give them an advantage during night raid missions against the German Luftwaffe fighters.

Claroxan's unique proprietary formulation is completely safe, all-natural and extremely affordable. As far as ordering it, you can call them toll-free at 866.775.3937, or go to www.claroxan.com. I usually get mine within a week after ordering.

Hope this helps!
Brian

THE Himalayan CATARACT project

The Himalayan Cataract Project strives to eradicate preventable and curable blindness in the Himalayas through high-quality ophthalmic care, education, and establishment of a sustainable eye care infrastructure.

Based in Asia, at Kathmandu in Nepal, the Project is empowering local physicians to alleviate the suffering caused by blindness through unique programs including skills-transfer education, cost-recovery, research, and the creation of a world-class network of eye care facilities.

In years past, PacificHealth donated a portion of profits to HCP for development and construction of eye facilities in the Himalayas.

Visit CureBlindness.org to learn more about HCP.



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Sunlight, aging, and diet each cause damage to the retina and macula, which can lead to a decline in vision that glasses or contacts can't help. If you've experienced an increase in blurriness or have difficulty seeing details at any range, then you know how valuable sharp vision can be. What you might not know is that in the past three years, a flood of new scientific research has been done on natural vision enhancement. This medical research suggests that ingredients in Claroxan™ may help maintain and even improve your vision, while at the same time giving you added protection against many ocular diseases.

Claroxan™ may improve macular pigment density, which research shows has amazing effects on vision. By improving macular pigment density, ingredients in Claroxan™ may improve normal

visual acuity, contrast sensitivity, and even glare reduction. Participants in one clinical study reported that ingredients in Claroxan™ improved their long range vision outdoors – in some cases, they were able to distinguish far away ridges up to 27 miles further than normal! Even if you have perfect vision now, Claroxan™ may help give you an edge by improving your visual reflexes and may allow you to pick up on moving objects faster than ever before.

People who count on their vision – people like pilots, hunters, military, and even pro athletes – trust Claroxan™ as the best source available for vision enhancement and protection. Claroxan™ is safe, effective, and extremely affordable. However, people with serious health concerns should consult a doctor before use.



>>> Excerpt <<<

Beyond Pearl Harbor: The Untold Stories of Japan's Naval Airmen

by Ron Werneth. Schiffer Military History, 2008. 288 pp., \$59.95.

THE INITIAL FEELING after shooting down someone was relief, because it was not me who was shot down. My next thought was that I was a better pilot, so I felt superior to the enemy aviator who was shot down. These feelings lasted only for a short time. When we shot at each other, we were at very close range, and during this time I could see my opponent's face very well. When I saw the enemy's face, it looked terrible because he was going down.

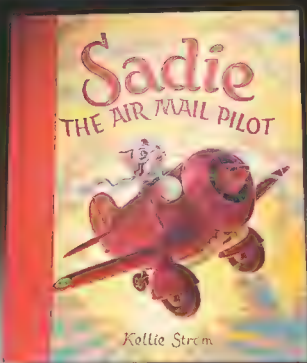
Soon after this I felt very bad, because I could imagine that my opponent had a family of his own, and I killed him. Therefore, to this day I feel very bad about shooting down pilots during the war. In general, I have a bad feeling about being involved in the war, and I feel guilty about killing other people in combat. I also feel that the war should not have happened in the first place. This is because the governments of countries around the world don't make an effort to resolve their differences. Instead, they order their armed forces to kill each other. I believe World War II veterans know this best, because we were used as "pawns" by our government to fight a war.



FORMER FIGHTER PILOT HARADA-SAN SPEAKS:

A historian of Japanese naval aviation, Ron Werneth lived in Japan for three years, where he met and interviewed the nation's last surviving World War II navy pilots and mechanics. The following excerpt is from Werneth's interviews with Kaname Harada, who flew Zero fighters in combat over the Pacific during World War II.

>>> Cool Stuff for Kids <<<



ERIC LONG (3)

THIS LITTLE TEDDY is all set to walk on the moon. His surface-washable spacesuit has a clear plastic faceplate and a life-support backpack. Suitable for ages 3 and up, the astronaut bear stands 12 inches tall. \$15.

IF YOUR CHILD LIKES AIRPLANES – and cats – this is the book for him or her. *Sadie the Air Mail Pilot* by Kellie Strom (David Fickling Books, 2007) tells the story of an orange tabby named Sadie who braves fierce weather to deliver the mail to the Knuckle Peak Weather Station. \$16.99.



WHAT ASPIRING PILOT WOULDN'T WANT this smart bomber jacket? The front sports two generously cut snap pockets. The polyurethane outer shell can be cleaned with a damp cloth, while the inner lining depicts a pilot's sectional chart. Available in sizes 3T, 4T, 6/8, 10/12 and 14/16. \$65.



All items can be purchased from the National Air and Space Museum gift shop by calling (202) 357-1387 or -1388. For additional gift ideas, visit www.smithsonianstore.com.

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Forecast

IN THE WINGS AND ON THE WEB...

IN THE NEXT ISSUE



Rough and Tumble

The airplanes plummet nose over tail, wingtip over wingtip, seemingly out of control. Find out why airshow performances have become increasingly perilous.

Tips From the Pros

Professional photographers reveal the secrets to getting the best airshow shots.

PLUS

The Man Who's Flown Everything

Guess who?

LEGENDS OF VIETNAM, THIRD IN A SERIES

Achilles' Heel

The traits that made the Grumman A-6 Intruder so valuable during the war – its ability to fly at treetop height and hit targets in any weather – made it vulnerable to enemy fire.

One-Way Ticket to Pluto

After an eight-year journey, what will NASA's New Horizons spacecraft find when it reaches the solar system's most distant body?

Pilots and Airplanes of the Spanish Civil War

World War I met World War II in the skies over Guernica.

Now on www.airspacemag.com

LUNAR SCIENTIST Paul Spudis blogs about the space program. Other Web-only features include NASA's animated fly-around of the International Space Station.

This 1915 ragtime composition is one of 1,500 pieces of aeronautical sheet music in the National Air and Space Museum. Trace the history of aeronautics through song in our newest photo gallery. Also look through a gallery of pets that fly in "Animals Aloft," photos by John Dibbs in "Warbird Obsession," and "The Flying White House," a gallery of Air Force One aircraft.



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Credits

Shooting Up a Shooting Star. Joe D'Amario's U.S. Air Force career, which started in 1950, took him through prop-driven aircraft, single-engine jets, and eventually the many-engine B-47 and B-52.

The Bonneville Jet Wars. Preston Lerner has visited Bonneville, but sadly, he's never seen a jet-powered car on the salt.

License to Thrill. Michael Belfiore is the author of *Rocketeers: How a Visionary Band of Business Leaders, Engineers, and Pilots Is Boldly Privatizing Space* and a forthcoming book about the Defense Advanced Research Projects Agency.

Woe Canada. A graduate of the U.S. Naval Test Pilot School, Calgary-based writer Graham Chandler can be reached through his Web site, www.grahamchandler.ca.

A Walk in the Airpark. Del Wilber, a private pilot, is the former aviation writer for the *Washington Post*.

Supersonic Sales Call. Jorge and Karen Escalona wrote "Lockheed's Missing Link" (June/July 2008).

Lunar Smackdown. Mohi Kumar is a journalist in Washington, D.C.

How Things Work: Flying Fuel Cells. Michael Klesius is an associate editor at *Air & Space/Smithsonian*.

Max Q Live. Michael Cassutt is a novelist and television writer in Studio City, California.

Bring Back the Brute. Robert Bernier, a former Navy pilot, flies for American Airlines.

Thuds, the Ridge, and 100 Missions North. Long-time contributor Carl Posey writes from Alexandria, Virginia.

A Weighty Matter. Roger A. Mola is a researcher at *Air & Space*.

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Nobody's Fuel...Yet

LAST OCTOBER, a California entrepreneur named Leonard Johnson set out on a transcontinental flight to First Flight Airport in Kitty Hawk, North Carolina, in a homebuilt airplane powered by “bio-butanol,” a fuel obtained from fermented plant material. Butanol is a form of alcohol like the ethanol that’s blended with automotive gasolines; the butanol molecule has a chain of four carbon atoms instead of ethanol’s two. The extra two carbons make butanol a bit more like gasoline than ethanol is, giving it such properties as greater energy density—an important factor for vehicle endurance and range. Johnson’s goal is to replace the 100-octane low-lead aviation gasoline that currently powers light airplanes with butanol made from plants.

His Cozy, a four-seat canard configuration that looks like a larger version of a Vari-Eze, was powered by a four-cylinder Lycoming O-360, which is rated at 180 horsepower when it runs on avgas. Using parts supplied by sponsoring organizations, mechanics modified his engine to run on butanol. On October 28, Johnson took off from Chino, California, and made his first stop, at Amarillo, Texas. At the next planned stop, Fort Smith, Arkansas, Johnson took off but immediately experienced a problem and returned to the airport to deal with it: The number-three cylinder, installed only 30 hours earlier, was running hot

Leonard Johnson's goal is to replace the 100-octane low-lead aviation gasoline that currently powers light airplanes with butanol made from plants.

and causing the engine to run rough. Tim Rogers, a local mechanic, found small cracks around the spark plug seat and replaced the cylinder, but the problem recurred en route to the next stop, Memphis, Tennessee.

In Johnson’s account of the flight, which he posted on his Web site (www.looklocal.org), he notes that experimental aircraft often use electronic ignition instead of traditional aircraft magnetos to generate spark in the engines. They also may use automotive-type spark plugs, which, under certain

circumstances, may not prevent hot gases from leaking out of the cylinder near the plug. On this long flight, those hot gases had leaked and, like a torch, created a passage where air could enter the cylinder, causing the mixture to run too lean at high power settings,

This Cozy made it across the country on fermented-plant fuel.

thereby overheating the cylinder.

Once again ship-shape, Johnson made it into First Flight Airport on Sunday, November 2, and received a miniature replica of the Wright Brothers National Memorial from the First Flight Foundation. He even got to dine at the very restaurant where Orville and Wilbur are said to have sent the telegram announcing their success in 1903.

For the return flight, Johnson switched to avgas, and on the first leg he experienced yet another overheating problem. As he attempted to make a precautionary landing in Osceola, Missouri, he ran into high winds and lost control. The airplane hit some power poles and lost both wings. Although seriously injured, Johnson survived, and his belief that technology—and plants—can provide future fuels for our aircraft survived with him.

■ ■ ■ GEORGE C. LARSON, MEMBER, NAA



RICHARD ESSIG

VISIT THE NAA WEB SITE AT WWW.NAA.AERO OR CALL (800) 644-9777.